LTG

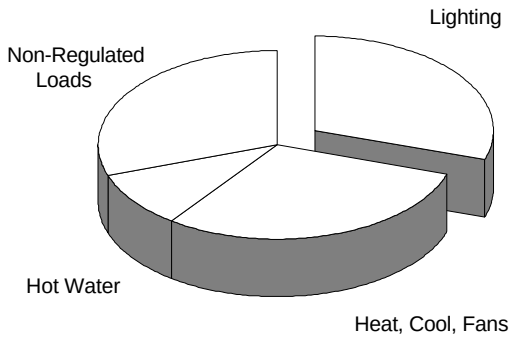
Chapter 5: Lighting Systems

5.0 CHAPTER OVERVIEW

This chapter covers the *Energy Efficiency Standards* that affect lighting design and installation, including lighting controls. It is addressed primarily to lighting designers or electrical engineers and to building department personnel responsible for lighting and electrical plan checking and inspection. Additional information is found in Chapter 2: Scope and Application, and in Chapter 6: Special Topics.

Chapter Contents

5.0 Chapter Overview 5-1
5.1 Introduction 5-2
5.1.1 Lighting Compliance Approaches 5-2
5.1.2 Basic Lighting Concepts and Definitions 5-3
A. Lighting Trade-Offs 5-3
B. Definitions 5-4
C. Occupancy Type 5-7
D. Lighting Controls 5-9
5.2 Lighting Design Procedures 5-10
5.2.1 Mandatory Measures 5-10
A. Area Controls 5-10
B. Bi-Level Switching 5-11
C. Daylit Areas 5-11
D. Shut-Off Controls 5-16
E. Display Lighting 5-18
F. Exterior Lights 5-18
G. Tandem Wiring 5-18
H. Certified Automatic Lighting Control Devices 5-18
I. Certified Ballasts and Luminaires 5-20
J. High Rise Residential Living Quarters & Hotel/ Motel Guest Rooms 5-21
5.2.2 Prescriptive Approach 5-24
A. Complete Building Method 5-24
B. Area Category Method 5-25
C. Tailored Method 5-28
D. Simplification for Tenant Spaces 5-36
E. Summary 5-36
5.2.3 Performance Approach 5-40
5.2.4 Actual Lighting Power 5-40
A. Exempt Lighting 5-40
B. Actual Lighting Power Calculations 5-41
C. Automatic Lighting Control Credits 5-43
5.2.5 Alterations 5-43
5.3 Lighting Plan Check Documents 5-46
5.3.1 LTG-1: Certificate of Compliance 5-46
A. LTG-1 Part 1 of 2 5-46
B. LTG-1 Part 2 of 2 5-51
C. Sample Form: LTG-1 5-52
5.3.2 LTG-2: Lighting Compliance Summary 5-54
A. Actual Lighting Power 5-54
B. Allowed Lighting Power 5-54
C. Sample Form: LTG-2 5-56
5.3.3 LTG-3: Lighting Controls Credit Worksheet 5-57
A. Sample Forms: LTG-3 5-58
5.3.4 LTG-4: Tailored LPD Summary and Worksheet 5-59
A. LTG-4: Part 1 of 3 5-59
B. LTG-4: Part 2 of 3 5-60
C. LTG-4: Part 3 of 3 5-61
D. Sample Form: LTG-4 5-64
5.3.5 LTG-5: Room Cavity Ratio Worksheet (≥ 3.5) 5-67
A. Rectangular Spaces 5-67
B. NonRectangular Spaces 5-67
C. Sample Form: LTG-5 5-68
5.4 Lighting Inspection 5-69



Energy Efficiency Report, October, 1990, California Energy Commission Publication No. 400-90-003

Figure 5-1: Lighting Energy Use
Lighting accounts for 29% of all commercial building electricity use in California.

The Introduction section (5.1) explains the alternative compliance approaches for lighting and introduces the basic lighting concepts necessary to understand the requirements. The Lighting Design Procedures section (5.2) covers the mandatory, prescriptive, and performance requirements for the lighting systems. For the convenience of designers, a summary of the most important requirements for design and layout of the lighting and control concepts is included. The Lighting Plan Check Documents section (5.3) describes the information that must be included in the building plans to show compliance with the *Standards*. The compliance forms are presented and discussed. The Lighting Inspection section (5.4) refers to the Inspection Checklist in Appendix I identifying the items that the inspector will verify in the field.

5.1 INTRODUCTION

Lighting is one of the single largest consumers of energy (kilowatt-hours) in a commercial building (Figure 5-1). The effective reduction of this energy use, without compromising the quality of lighting or task work, is the objective of the lighting energy standards. These *Standards* are the result of the involvement of many representatives of the lighting design and manufacturing community, and of building departments across the state. A great deal of effort has been devoted to making the lighting requirements practical and realistic. This chapter summarizes those requirements and the approaches to complying with them.

5.1.1 Lighting Compliance Approaches

The primary mechanism for regulating lighting energy under the *Standards* is to limit the allowable lighting power (watts) installed in the building. Other mechanisms require basic equipment efficiency, and require that the lighting is controlled to permit efficient operation.

MANDATORY MEASURES apply to all lighting systems and equipment (Sections 119, 130, 131 and 132). These requirements may include manual switching, daylit area switching, automatic shut-off controls, and tandem wiring for ballasts. The mandatory requirements must be met under either the prescriptive or performance approach.

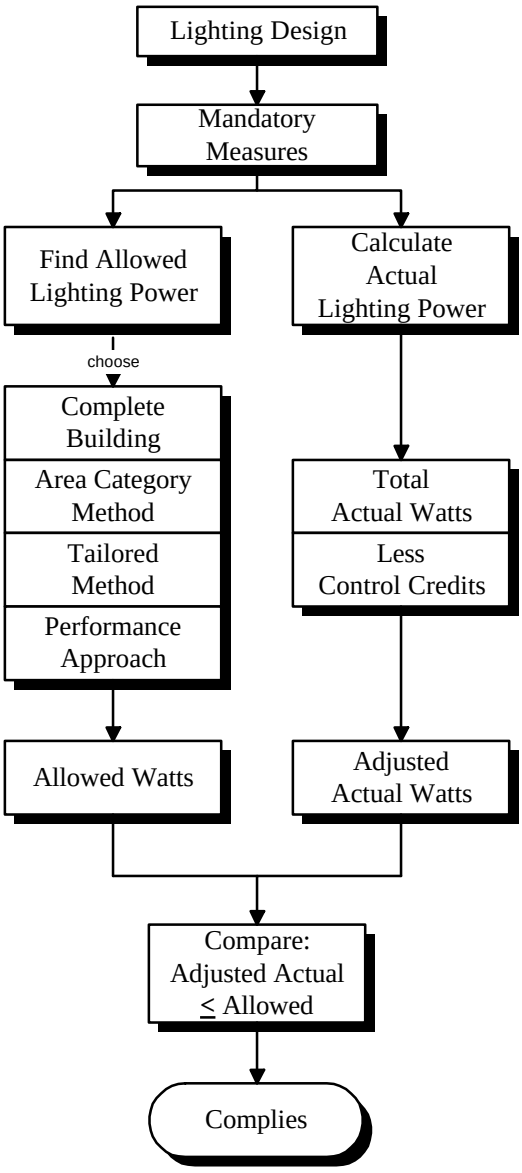
ALLOWED LIGHTING POWER for a building is determined by one of four methods:

Complete Building Method: applicable when the entire building's lighting system is designed and permitted at one time. In some cases the Complete Building Method may be used for an entire tenant space in a multi-tenant building. A single lighting power value governs the entire building (Section 146(b)1). See Section 5.2.2A for other applications of the complete building method. See Section 5.1.2A and Appendix G for definition of Entire Building.

Area Category Method: applicable for any permit situation, including tenant improvements. Lighting power values are assigned to each of the major function areas of a building (offices, lobbies, corridors, etc.) (Section 146(b)2).

Tailored Method: applicable when additional flexibility is needed to accommodate special task lighting needs. Lighting power allowances are determined room-by-room and task-by-task (Section 146(b)3).

Figure 5-2: Lighting Compliance Flowchart



Performance Approach: applicable when the designer uses an approved computer program to demonstrate that the lighting power in the proposed design meets the energy budget. The performance approach requires the use of an Energy Commission certified computer program and may only be used to model the performance of lighting systems that are covered under the building permit application (see section 5.2.3).

ACTUAL LIGHTING POWER (ADJUSTED) is based on total design wattage of lighting, less adjustments for any lighting control credits taken for non-mandatory controls, such as occupant-sensing devices, lumen maintenance controls, or automatic daylighting controls (Section 146(a)).

The Actual Lighting Power (Adjusted) must not exceed the Allowed Lighting Power for the lighting system to comply.

5.1.2 Basic Lighting Concepts and Definitions

This section includes key concepts and definitions from the *Standards* that apply to the lighting and control systems.

A. Lighting Trade-offs

The *Standards* restrict the overall installed lighting power in the building, regardless of the compliance approach. However, there is no general restriction regarding where or how general lighting power is used. This means that installed lighting may be greater than the *Standards* allowances in some areas of the building and lower in others, as long as the total does not exceed the Allowed Lighting Power.

Example 5-1: Lighting Trade-Offs: General Lighting

Question

Under the Area Category Method, a mixed use building is determined to have an allowed lighting power of 23,500 watts. As part of this determination, an office area within the building is found to have an allowance of 1.6 watts/ft^2. One of the private offices within this area is designed with an actual lighting power density of 2.0 watts/ft^2. Is this permitted?

Answer

Yes. Provided the actual lighting power of the entire building does not exceed the 23,500 watt limit, there is no limit on the individual office.

This is true for general lighting no matter what method is used to determine the allowed lighting power.

Note that in Examples 5-1 and 5-2, it is not necessary to specify precisely where the watts come from when a trade-off occurs. These details are not needed for compliance; any individual trade-offs are included in the totals. It is necessary only to demonstrate that the actual watts total for the building does not exceed the total allowable. Trade-offs are not allowed with so-called use it or lose it categories of lighting. These are specific task or display lighting applications, such as chandeliers under the Area Category Method (Section 5.2.2B) or display lighting under the Tailored Method (Section 5.2.2C), where the allowable lighting power for the application is determined from:

1. wattage allowance specified by the *Standards*

2. actual wattage of the fixture(s) assigned to the application

For *use it or lose it* applications, the allowable lighting power is the lesser of these two wattages. This means that the actual wattage is lower than the allowance. Both the remaining watts in the allowance and the actual wattage are not available for trade-off to other areas of the building.

Example 5-2: Lighting Trade-offs: Display Lighting Part 1

Question

A display lighting application (one of the "use it or lose it" applications) is determined to have a lighting power allowance of 350 watts. The actual luminaires specified for the display total 300 watts. How does this affect the allowed watts and the actual watts (adjusted if applicable) for the building?

Answer

The lower value, 300 watts, is shown as total allowed watts for the building. The actual lighting power is also 300 watts. There are no watts available for use through trade-offs elsewhere in the building.

Example 5-2: Lighting Trade-offs: Display Lighting Part 2

Question

A display lighting application is determined to have a lighting power allowance of 500 watts. The actual luminaires specified for the display total 600 watts. How does this affect the allowed watts and the actual watts (adjusted if applicable) for the building?

Answer

As before, the lower value, 500 watts in this case, is shown as the total allowed watts for the display. The proposed lighting power will include the full 600 watts. For the building lighting to comply, the extra 100 watts used by the display fixtures must be eliminated from elsewhere in the building.

Lighting control credits reduce the actual installed watts, making it easier to meet the allowed watts. This can have the same effect as trade-offs.

The specific calculations involved in the trade-offs discussed in this section are carried out on the compliance forms presented in Section 5.3.

There is another type of lighting trade-off available under the *Standards*. This is the ability to make trade-offs under the performance approach between the lighting system and the envelope or mechanical systems. Trade-offs can only be made when permit applications are sought for those systems involved, and where the trade-off has the effect of altering the Allowed Lighting Power for the building. When a Lighting Power Allowance is calculated using the performance approach, the allowance is treated exactly the same as an allowance determined using one of the other compliance methods.

B. Definitions

Included in this section are definitions of terms other than occupancy type and terms specific to controls that have application to compliance with the lighting requirements of the *Standards*.

Accessible is having access thereto, but which first may require removal or opening of access panels, doors, or similar obstructions.

Annunciated is a visual signaling device that indicates the on, off, or other status of a load.

Chandeliers (see Ornamental Chandelier)

Complete Building is an entire building with one occupancy making up 90 percent of the conditioned floor area (see also Entire Building).

Daylit Area is the space on the floor that is the larger of (a) plus (b), or (c);

(a) For areas daylit by vertical glazing, the daylit area has a length of 15 feet, or the distance on the floor, perpendicular to the glazing, to the nearest 60-inch or higher opaque partition, whichever is less; and a width of the window plus either 2 feet on each side, the distance to an opaque partition, or one-half the distance to the closest skylight or vertical glazing, whichever is least.

(b) For areas daylit by horizontal glazing, the daylit area is the footprint of the skylight plus, in each of the lateral and longitudinal dimensions of the skylight, the lesser of the floor-to-ceiling height, the distance to the nearest 60-inch or higher opaque partition, or one-half the horizontal distance to the edge of the closest skylight or vertical glazing.

(c) The daylit area calculated using a method approved by the Energy Commission.

Display Lighting is lighting confined to the area of a display that provides a higher level of illuminance than the level of surrounding ambient illuminance.

Display, Public Area are areas for the display of artwork, theme displays, and architectural surfaces in dining and other areas of public access, excluding restrooms and separate banquet rooms.

Display, Sales Feature is an item or items that requires special highlighting to visually attract attention and that is visually set apart from the surrounding area.

Display, Sales Feature Floor is a feature display in a retail store, wholesale store, or showroom that requires display lighting.

Display, Sales Feature Wall are the wall display areas, in a retail or wholesale space, that are in the vertical plane of permanent walls or partitions, and that are open shelving feature displays or faces of internally illuminated transparent feature display cases within the Gross Sales Wall Area.

Effective Aperture (EA) is (1) for windows, the visible light transmittance (VLT) times the window wall ratio; and (2) for skylights, the well index times the VLT times the skylight area times 0.85 divided by the gross exterior roof area.

Efficacy is the ratio of light from a lamp to the electrical power consumed (including ballast losses), expressed in lumens per watt.

Entire Building is the ensemble of all enclosed space in a building, including the space for which a permit is sought, plus all existing conditioned and unconditioned space within the structure.

High Bay is a space with luminaires 25 feet or more above the floor.

Low Bay is a space with luminaires less than 25 feet above the floor.

Luminaire is a complete lighting unit consisting of a lamp and the parts designed to distribute the light, to position and protect the lamp, and to connect the lamp to the power supply; commonly referred to as "lighting fixtures" or "instruments."

Newly Conditioned Space is any space being converted from unconditioned to directly conditioned or indirectly conditioned space, or any space being converted from semi-conditioned to directly conditioned or indirectly conditioned space. Newly conditioned space must comply with the requirements for an addition. See Section 149 for nonresidential occupancies and Section 152 for residential occupancies.

Ornamental Chandelier are ceiling-mounted, close-to-ceiling, or suspended decorative luminaires that use glass, crystal, ornamental metals, or other decorative material and that typically are used in hotel/motels, restaurants, or churches as a significant element in the interior architecture.

Poor Quality Lighting Tasks are visual tasks that require illuminance category "E" or greater, because of the choice of a writing or printing method that produces characters that are of small size or lower contrast than good quality alternatives that are regularly used in offices.

Private Office or Work Area is an office bounded by 30-inch or higher partitions and is no more than 200 square feet.

Primary Function Area is one of the categories listed in Table 5-4.

Public Areas are spaces generally open to the public at large, customers, congregation members, or similar spaces, where occupants need to be prevented from controlling lights for safety, security, or business reasons.

Readily Accessible is capable of being reached quickly for operation, repair, or inspection, without requiring climbing or removing obstacles, or resorting to access equipment.

Reduced Flicker Operation is the operation of a light, in which the light has a visual flicker less than 30% for frequency and modulation.

Room Cavity Ratio (RCR) is:

(a) for rectangular rooms; $\frac{5H\,(L + W)}{LW}$

or

(b) for irregular shaped rooms $\frac{2.5\,H \times P}{A}$

Where:

- L = Length of room
- W = Width of room
- H = Vertical distance from the work plane to the center line of the lighting fixture
- P = Perimeter of room
- A = Area of room

Sconce is a wall mounted decorative light fixture.

Skylight is glazing having a slope less than 60 degrees from the horizontal with conditioned space below, except for purposes of complying with Section 151(f), where a skylight is glazing having a slope not exceeding 4.76 degrees (1:12) from the horizontal.

Throw Distance is the distance between the luminaire and the center of the plane lit by the luminaire on a display.

Very Valuable Merchandise is rare or precious objects, including, but not limited to, jewelry, coins, small art objects, crystal, china, ceramics, or silver, the selling of which involves customer inspection of very fine detail from outside of a locked case.

Visible Light Transmittance (VLT) is the ratio (expressed as a decimal) of visible light that is transmitted through a glazing material to the light that strikes the material.

Well Index is the ratio of the amount of visible light leaving a skylight well to the amount of visible light entering the skylight well and is calculated as follows:

(a) for rectangular wells:

$$\left(\frac{well\ height(well\ length + well\ width)}{2\ X\ well\ length\ X\ well\ width}\right)$$

or

(b) for irregular shaped wells:

$$\left(\frac{WellHeightXWellPerimeter}{4XWellArea}\right)$$

Where the length, width, perimeter, and area are measured at the bottom of the well, and R (as used in Figure 5-7) is the weighted average reflectance of the walls of the well.

Window Wall Ratio is the ratio of window area to the exterior wall area, measured from floor to ceiling (this definition is unique to lighting applications).

Zone, Lighting is a space or group of spaces within a building that has sufficiently similar requirements so that lighting can be automatically controlled in unison throughout the zone by an illumination controlling device or devices, and does not exceed one floor.

C. Occupancy Type

The *Standards* recognize the fact that different building occupancies primary functions require different amounts of lighting power to provide adequate illumination for their various types of visual tasks. The allowed lighting power in the *Standards* depends on the occupancy.

Each of the occupancy primary function types listed may be used to determine the lighting power density (watts per square foot) for the Area Category Method (see Table 5-4). Some of these same primary function types can also use the Complete Building Method (see Table 5-3). The Standard definitions of the occupancy types are listed below.

- *Auditorium*: the part of a public building where an audience sits in fixed seating, or a room, area, or building with fixed seats used for public meetings or gatherings not specifically for the viewing of dramatic performances.

- *Auto Repair*: The portion of a building used to repair automotive equipment and/or vehicles, exchange parts, and may include work using an open flame or welding equipment.

- *Bank/Financial Institution*: An area in a public establishment used for conducting financial transactions including the custody, loan, exchange, or issue of money, for the extension of credit, and for facilitating the transmission of funds.

- *Classroom, Lecture, or Training*: A room or area where an audience or class receives instruction.

- *Commercial and Industrial Storage*: A room, area, or building used for storing items.

- *Convention, Conference, Multipurpose and Meeting Centers*: An assembly room, area, or building that is used for meetings, conventions and multiple purposes including, but not limited to, dramatic performances, and that has neither fixed seating nor fixed staging.

- *Corridor*: A passageway or route into which compartments or rooms open.

- *Dining*: A room or rooms in a restaurant or hotel/motel (other than guest rooms) where meals that are served to the customers will be consumed.

- *Electrical/Mechanical Room*: A room in which the building's electrical switchbox or control panels, and/or HVAC controls or equipment is located.

- *Exercise Center/Gymnasium*: A room or building equipped for gymnastics, exercise equipment, or indoor athletic activities.

- *Exhibit*: A room or area that is used for exhibitions that has neither fixed seating nor fixed staging.

- *General Commercial and Industrial Work*: A room, area, or building in which an art, craft, assembly or manufacturing operation is performed.

    High Bay: Luminaires 25 feet or more above the floor.

    Low Bay: Luminaires less than 25 feet above the floor.

- *Grocery Store*: A room, area, or building that has as its primary purpose the sale of foodstuffs requiring additional preparation prior to consumption.

- *Hotel Function Area*: A hotel room or area such as a hotel ballroom, meeting room, exhibit hall, or conference room, together with prefunction areas and other spaces ancillary to its function.

- *Hotel Lobby*: The contiguous spaces in a hotel/motel between the main entrance and the front desk, including waiting and seating areas, and other spaces encompassing the activities normal to a hotel lobby function.

- *Kitchen/Food Preparation*: A room or area with cooking facilities and/or an area where food is prepared.

- *Laundry*: A place where laundering activities occur.

- *Library*: A repository for literary materials, such as books, periodicals, newspapers, pamphlets and prints, kept for reading or reference.

- *Locker/Dressing Room*: A room or area for changing clothing, sometimes equipped with lockers.

- *Lounge/Recreation*: A room used for leisure activities which may be associated with a restaurant or bar.

- *Main Entry Lobby/Reception/Waiting*: The lobby of a building that is directly located by the main entrance of the building and includes the reception area, sitting areas, and public areas.

- *Malls, Arcades and Atria*: A public passageway or concourse that provides access to rows of stores or shops.

- *Medical and Clinical Care*: A room, area, or building that does not provide overnight patient care and that is used to promote the condition of being sound in body or mind through medical, dental, or psychological examination and treatment, including, but not limited to, laboratories and treatment facilities.

- *Museum*: A space in which works of artistic, historical, or scientific value are cared for and exhibited.

- *Office*: A room, area, or building of UBC group B occupancy other than restaurants.

- *Precision Commercial or Industrial Work*: A room, area, or building in which an art, craft, assembly or manufacturing operation is performed involving visual tasks of small size or fine detail such as electronic assembly, fine woodworking, metal lathe operation, fine hand painting and finishing, egg processing operations, or tasks of similar visual difficulty.

- *Reception/Waiting Area*: An area where customers or clients are greeted prior to conducting business.

- *Religious Worship*: A room, area, or building for worship.

- *Restaurant*: A room, area, or building that is a food establishment as defined in Section 27520 of the Health and Safety Code.

- *Restroom*: A room or suite of rooms providing personal facilities such as toilets and washbasins.

- *Retail And Sales*: A room, area, or building in which the primary activity is the sale of merchandise.

- *School*: A building or group of buildings that is predominately classrooms and that is used by an organization that provides instruction to students.

- *Stairs, Active/Inactive*: A series of steps providing passage from one level of a building to another.

- *Support Area*: A room or area used as a passageway, utility room, storage space, or other type of space associated with or secondary to the function of an occupancy that is listed in these regulations.

- *Theater, Motion Picture*: An assembly room, hall, or building with tiers of rising seats or steps for the showing of motion pictures.

- *Theater, Performance*: An assembly room, hall, or building with tiers of rising seats or steps for the viewing of dramatic performances, lectures, musical events and similar live performances.

- *Vocational Room*: A room used to provide training in a special skill to be pursued as a trade.

- *Wholesale Showroom*: A room where samples of merchandise are displayed.

D. Lighting Controls (§146(a)2)

Automatic lighting controls are an important part of the lighting requirements of the *Standards*. Some types of controls are necessary to comply with mandatory requirements (see Section 5.2.1A), while others allow designers the ability to reduce the Actual Lighting Power in their designs (see Section 5.2.4C). Several types of automatic lighting controls are required to be certified and listed by the Energy Commission (see Section 5.2.1D).

The following control device definitions are important for understanding the requirements of the *Standards* (Section 101).

Annunciated *is a visual signaling device that indicates the on, off, or other status of a load.* Annunciators are part of the requirements for such devices as area controls and automatic time switches when the area being controlled is not visible from the device location.

Automatic Time Switch Control Devices *are devices capable of automatically turning loads off and on based on time schedules.* There are many types of control devices that can perform this function.

NOTE: Some automatic time switch controls may incorporate "automatic off " and a "manual on" function such as hourly "off sweeps" after closing, or relay switches that drop out when power is interrupted. These devices would typically comply with the mandatory automatic shut-off provisions of Section 131(d).

Captive-Key Override *is a type of lighting control in which the key that activates the override cannot be released when the lights are in the on position.*

Current Limiter is a lighting control device that limits the input power of a track lighting fixture or incandescent medium screw base socket to a specific maximum level. The Current Limiter (1) must be an integral part of the fixture, (2) must be hard-wired into the track or the incandescent medium screw base socket fixture, (3) can only be replaced by manufacturer authorized technicians, and (4) must have the voltage ampere (VA) rating clearly marked on the track or fixture.

Lighting Zone *is a space or group of spaces within a building that has sufficiently similar requirements so that lighting can be automatically controlled in unison throughout the zone by an illumination controlling device or devices.* A lighting zone does not exceed one floor.

Lumen Maintenance Device *is a device capable of automatically adjusting the light output of a lighting system throughout a continuous range to provide a preset level of illumination.* Lumen maintenance control devices and systems use dimmers to automatically adjust the light output of the lighting system in order to deliver the design illuminance.

A new lighting system may deliver 30 percent more light than is actually needed, but as the lamps age, their light output will decline. The lumen maintenance device reduces the initial input of electrical energy to new lamps until the light output is at the designed illuminance level, thus saving energy.

Multi-Scene Dimming System *is a lighting control device that has the capability of setting light levels throughout a continuous range, and that has pre-established settings within the range.* This type of device is able to save energy by providing a convenient way to dim lights and reduce lighting power. Lighting control credits are available for such devices in hotels/motels, restaurants, auditoriums and theaters.

Occupant-sensing Device *is a device that automatically turns lights off soon after an area is vacated.* Occupant sensors detect whether a room or space is occupied, and automatically turns the lights off when occupants are not present. Various techniques are used to sense the presence of an occupant, including sensing infrared radiation (heat) emitted from the occupant, ultrasonic waves that sense changes in wave patterns when the room is occupied, and microwave radiation. These devices can be used to meet mandatory measure requirements; they can also be used to obtain lighting control credit for the building.

Tuning *is a lighting control device that allows authorized personnel only to select a single light level within a continuous range.* This type of device is able to save energy by providing a practical means of adjusting light output of a lighting system down to the specific level needed, rather than allowing excess illumination and consuming full power.

5.2 LIGHTING DESIGN PROCEDURES

This section discusses how the requirements of the Standards affect lighting system design. For procedures on documenting the lighting design, including compliance forms, see Section 5.3.

5.2.1 Mandatory Measures

The mandatory features and devices must be included in the building design whether compliance is shown by the prescriptive or the performance approach. These features have been proven cost-effective over a wide range of building occupancy types.

Many of the mandatory features and devices are requirements for manufacturers of building products, who must certify the performance of their products to the Energy Commission. It is the responsibility of the designer, however, to specify products that meet these requirements. Code enforcement officials, in turn, check that the mandatory features and specified devices are installed.

The mandatory requirements for lighting control devices (§119) specify minimum features for automatic time switch controls, occupancy sensors, automatic daylighting controls, lumen maintenance controls, and interior photocell sensors. Such devices must be certified to the Energy Commission by the manufacturer. Many of these requirements are part of standard practice in California and should be well understood by those responsible for designing or installing lighting systems.

A. Area Controls (§131(a))

The simplest way to improve lighting efficiency is to turn off the lights when they are not in use. All lighting systems must have switching or control capabilities to allow lights to be turned off when they are not needed.

Room Switching (§131(a)1) Independent lighting controls are required for each area enclosed by ceiling height partitions. In the simplest case, this means that each room must have its own switching; gang switching of several rooms is not allowed. The switch may be either a manual switch, an automatic control, or an occupancy sensor.

Accessibility (§131(a)1.A & B) All manually operated switching devices must be located so that personnel can see the controlled area when operating the switch(es). When not located within view of the lights or areas, the switch shall be annunciated to indicate the status of the lights (on or off).

Security or Emergency (§131(a) Exception No. 1) Lighting in areas within a building that must be continuously illuminated for reasons of building security or emergency egress are exempt from the switching requirements for a maximum of 0.5 watt per square foot. These lights must be designated as security or emergency egress areas on the plans, and the lights must be controlled by switches accessible only to authorized personnel. The remaining lighting in the area, however, is still subject to the area switching requirements.

Public Areas (§131(a) Exception No. 2) In public areas, such as building lobbies, concourses, etc., the switches may be located in areas accessible only to authorized personnel.

Other Devices (§131(a)2) If the room switching operates in conjunction with any other kind of lighting control device, there are two other requirements: 1) the other control device must allow the room switching to override its action, and 2) if the other control device is automatic, it must automatically reset to its normal operation mode without any further action.

For example, if there is an automatic control system that sweeps all the lights off in a group of offices at a certain hour, the room switch in any individual office must be able to override the sweep and turn the office's lights back on. The next time the automatic control sweeps the lights off, however, the override for that individual office must not remain in effect but must return to automatic mode and shut the lights off.

Example 5-3: Shut-off Control Override

Question

A 5,000 square foot building will be equipped with an automatic control device to shut off the lights, in compliance with Section 131(b)--building shut-off. How are the local switches supposed to respond when an occupant wishes to turn on lights after the lights are shut off?

Answer

The local switch (as specified in Section 131(a)) must allow the occupant to override the shut off and turn on the lights in their area (Section 131(a)2.A.), Following the override, the automatic function of the shut-off must resume, so that when the automatic control sweeps the lights off, these lights will be shut off unless the local switch again overrides the shut-off (Section 131(a)2.B.).

Example 5-4: Manual Switches and Automatic Controls

Question

The card access system of a proposed building will automatically turn on the lobby and corridor lights when activated by someone entering the building after hours. In addition, the lobby and corridor lights are on an automatic time switch control. Are manual switches required for the lobby and corridor?

Answer

Yes. The manual switch is still required under the area control mandatory measure requirement. Furthermore, the manual switch must be able to turn off the lights when either the automatic time switch control or card access system has turned them on. The automatic devices must be automatically reset.

B. Bi-Level Switching §131(b))

Most areas in buildings must be controlled so that the connected lighting load may be reduced by at least 50 percent in a reasonably uniform illumination pattern. The intent of this requirement is to achieve the reduction without losing use of any part of the space (see Figure 5-3). This bi-level switching may be achieved in a variety of ways, such as:

- Separately switching "on" every other luminaire in each row (checkerboard)
- Separately switching "on" alternate rows of luminaires
- Using dimming controls
- Separately switching lamps in each luminaire

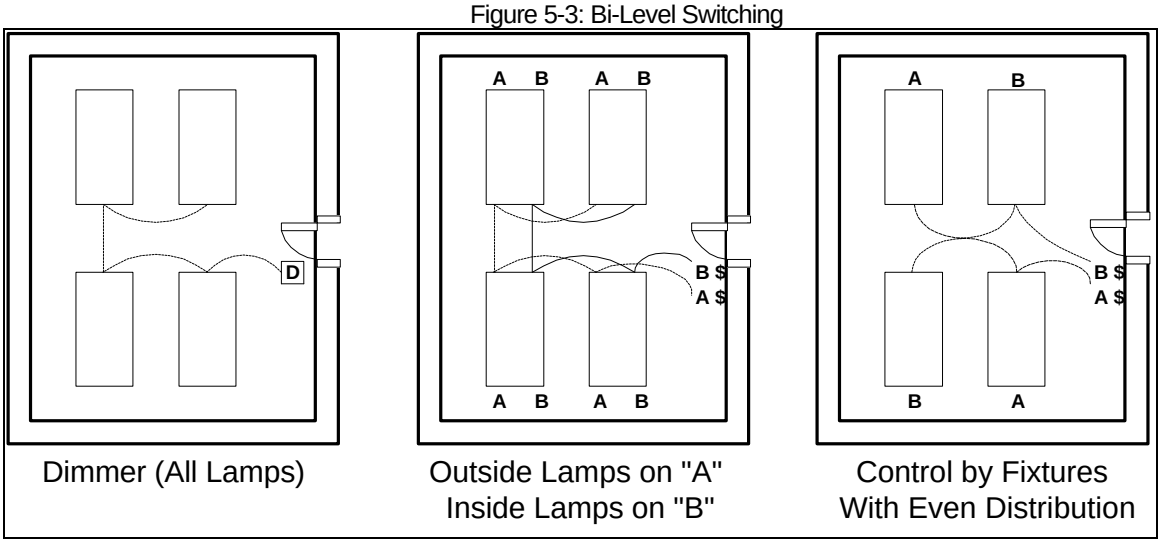
Bi-level switching is not required (Section 131(b) Exceptions 1, 2 and 3) when:

- The area has only one light source (luminaire),
- The area is less than 100 square feet,
- The lighting power density is less than 1.0 watts per square foot,
- The area is controlled by an occupant-sensing device,
- The area is a corridor, or
- An automatic time switch control device with a timed manual override switch independently controls each area that requires an individual switch.

C. Daylit Areas (§131(c))

The control of electric lighting in the area where daylighting enters a building through windows or skylights is addressed in the Standards. It falls under the mandatory requirement for separate switching in daylit areas, and may receive credit under the optional automatic controls

Figure 5-3: Bi-Level Switching



credits. Under the mandatory measures, where an enclosed space is greater than 250 square feet, the electric lighting within daylit area must be switched so that the lights can be controlled separately from the non-daylit areas (see definition of daylit area below). It is acceptable to achieve control in the daylit area by being able to shut off at least 50 percent of the lamps within the daylit area. This must be done by a control dedicated to serving only luminaires in the daylit area. If there are separate daylit areas for windows and skylights, they must be controlled separately.

The daylit area switching requirements are in addition to the bi-level switching requirements. Taken together, there are at least three ways to comply (see Figure 5-4). With the **4 Switch Option**, the bi-level switching is provided separately to the daylit area (within fifteen feet of the windows) and to the non-daylit area. The **3 Switch Option** also meets the requirements because switch "1" controls at least 50 percent of the lighting in the daylit area. Switch "2" controls the remainder of the lights in the daylit area and half of the lights in the non-daylit area. Switch "3" controls the remainder of lights in the non-daylit area. The **Dimmer Switch Option** controls the daylit and non-daylit areas separately, and the dimmer takes care of the bi-level illumination requirement. Daylight switching must be applied to a fixture if any portion of that fixture is within the daylit area.

The only exception to the requirement of providing the separate control to daylit areas is when there is not enough daylight to be used effectively. This is decided in one of two ways:

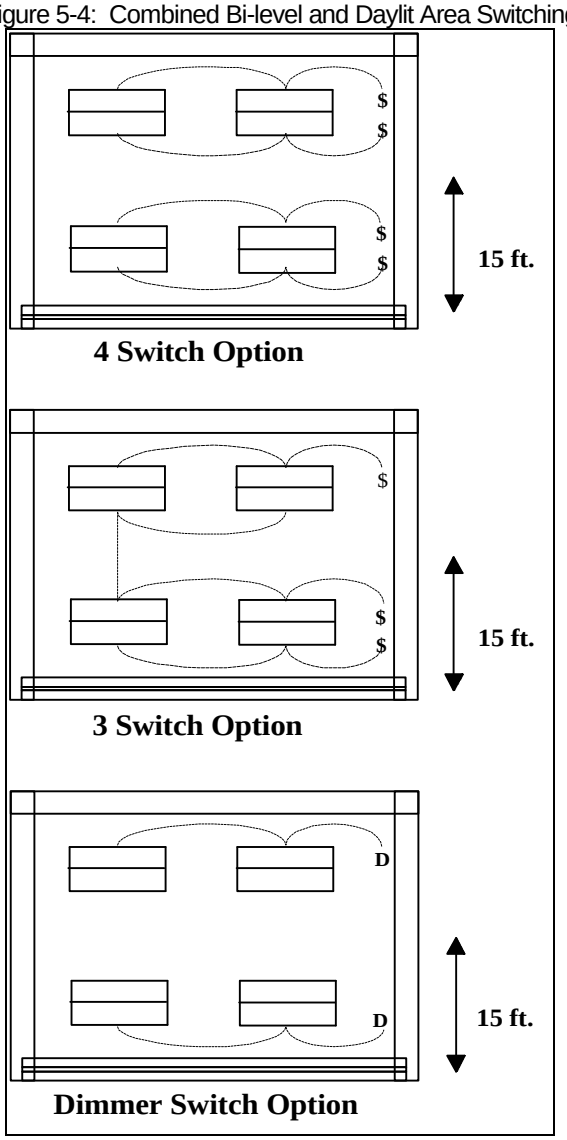
1. When the daylight to a window or skylight is so obstructed by adjacent structures, evergreen trees, or other natural objects that the effective use of daylighting is not reasonable. This determination must be made by the local enforcement agency.

2. When the effective aperture of the window is less than 0.1 (or of the skylight is less than 0.01). A low effective aperture prevents usable daylight from entering the area; it is caused by small glazing area, low transmission glazing materials, or a combination of both. (See definition of **Effective Aperture** below.)

Daylit Area is the space on the floor that is the larger of (a) plus (b), or (c);

(a) For areas daylit by vertical glazing, the daylit area has a length of 15 feet, or the distance on the floor, perpendicular to the glazing, to the nearest 60-inch or higher opaque partition, whichever is less; and a width of the window plus either 2 feet on each side, the distance to an opaque partition, or one half the distance to the closest skylight or vertical glazing, whichever is least *(see Figure 5-5)*.

Figure 5-4: Combined Bi-level and Daylit Area Switching



(b) For areas daylit by horizontal glazing, the daylit area is the footprint of the skylight plus, in each of the lateral and longitudinal dimensions of the skylight, the lesser of the floor-to-ceiling height, the distance to the nearest 60-inch or higher opaque partition, or one-half the horizontal distance to the edge of the closest skylight or vertical glazing *(see Figure 5-6)*.

(c) The daylit area calculated using a method approved by the Energy Commission. Such methods include DOE 2.1D and E, Superlite, Quicklite and other computer-based models that determine the daylit area based on modeling the features of the space.

Effective Aperture (EA) for windows equates to the visible light transmittance (VLT) times the window wall ratio. The EA for windows is calculated for each room with daylighting (see Table 5-1). The window wall ratio used in calculating EA is determined from the Exterior Wall Area of the room with the window(s) (measured from floor to ceiling), and from the windows area. Windows with an EA greater than or equal to 0.1 indicate sufficient daylight is available to require a separate control for the daylit area.

For the EA calculation of a skylight see Table 5-1.

NOTE:

The skylight-to-roof area ratio is determined from the skylight area and the gross exterior roof area of each daylit space. 0.85 is a dirt depreciation factor for the skylight.

See following pages for discussion of Well Index and (Visible Light Transmittance). See Section 3.1.2A for **Surface Definition** terms.

Table 5-1: Effective Aperture Matrix

Is Adequate Daylighting Available?

Glazing Type	**WINDOWS (Vertical Glazing** **Window/Wall Ratio** **< 0.10**	**0.10 to 0.20**	**0.20 to 0.40**	**> 0.40**
VLT > 0.60	NO	CALC*	YES	YES
VLT 0.35 to 0.59	NO	CALC*	CALC*	YES
VLT < 0.35	NO	NO	CALC*	CALC*

*Window EA = VLT x Window Wall Ratio

Glazing Type	**SKYLIGHTS (Horizontal Glazing)** **Skylight-to-Roof Area Ratio** **< 0.01**	**0.01 to 0.03**	**> 0.03**
VLT > 0.630	NO	CALC**	YES
VLT 0.35 to 0.59	NO	CALC**	YES
VLT < 0.35	NO	CALC**	CALC**

**Skylight EA =

$$\frac{\text{WI x VLT x Skylight-to-Roof Area Ratio x 0.85}}{\text{Gross Exterior Roof Area}}$$

NOTE: This skylight matrix does not account for well index (WI). If the skylight has a light well, the EA could be substantially lower. It is recommended that the EA be calculated in such cases.

Example 5-5: Effective Aperture Matrix

Question

A room has a window area of 90 sf. The exterior wall has a gross area of 180 sf. The window glazing has a visible light transmittance (VLT) of 0.31. Do the daylit area switching requirements apply in this room?

Answer

Yes. The window wall ratio (WWR) for the room is 90 sf / 180 sf = 0.50. The effective aperture, EA = 0.50 x 0.31 = 0.155, which is greater than 0.1 (exception for inadequate daylight does not apply). (With a WWR of 0.50 and a VLT of less than 0.35, the matrix in Table 5-1 also indicates that the EA is high enough that adequate daylighting is available). Daylighting control credits are available for the room (Table 5-10).

Table 5-1, above, can be used as a simplified method for calculating the EA. It indicates when the EA is low enough to invoke the exception to the requirements for daylight switching control. Each vertical column of the table corresponds to a window wall ratio or skylight-to-roof ratio range. Each horizontal row of the matrix corresponds to a range of VLTs. In questionable cases, indicated by "DO CALC" on Table 5-1, the EA should be calculated to obtain a precise answer as to whether the daylit area must be separately controlled.

If, instead of using Table 5-1, the EA is to be calculated, the following terms must also be understood.

Visible Light Transmittance (VLT) is a property of the glass or plastic glazing material. The value of VLT for a given material is found in the manufacturer's literature.

Example 5-6: Skylight/Daylit Area

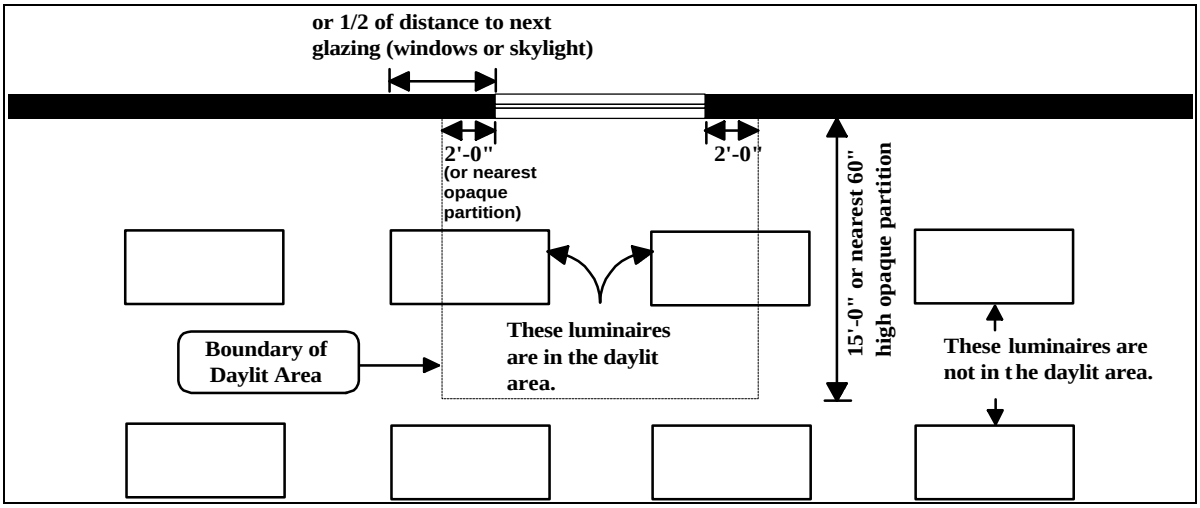
Question

What is the daylit area associated with the skylight shown in Figure 5-6**?**

Answer

The daylit area of the skylight is calculated from the length and width of the skylight footprint, and from the ceiling height (there are no opaque partitions or nearby windows/skylights). The length of the daylit area is the length of the skylight (10') plus the floor-to-ceiling height on each end (11' + 11'), for a total daylit area length of 32'. The width of the daylit area is the width of the skylight (5') plus the floor-to-ceiling height on each end (11' + 11') for a total daylit area length of 27'. The daylit area is its length times its width, or 32' x 27' = 864 sf.

Figure 5-5: Window Daylit Area



Well Index *(Efficiency of Well) is the ratio of the amount of visible light leaving a skylight well to the amount of visible light entering the skylight well . The Well Index is calculated as follows:*

(a) For rectangular wells:

Well index =

$$\frac{Well\ \ Height \times \left(well\ \ length + well\ \ width\right)}{2 \times well\ \ length \times well\ \ width}$$

or

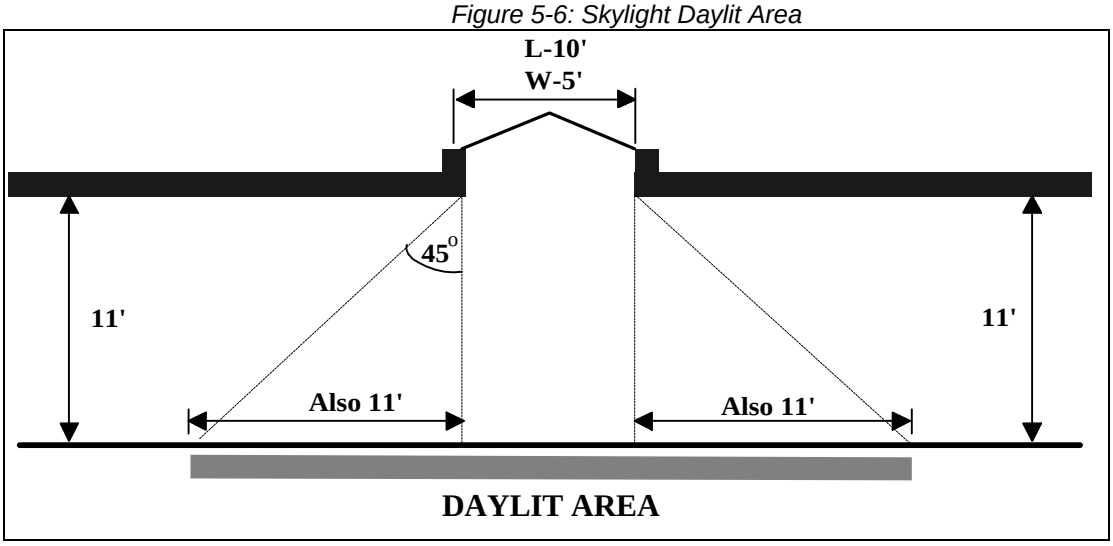
(b) for irregular shaped wells:

Well index =

$$\frac{\boldsymbol{Well\ \ height \times well\ \ perimeter}}{\boldsymbol{4 \times well\ \ area}}$$

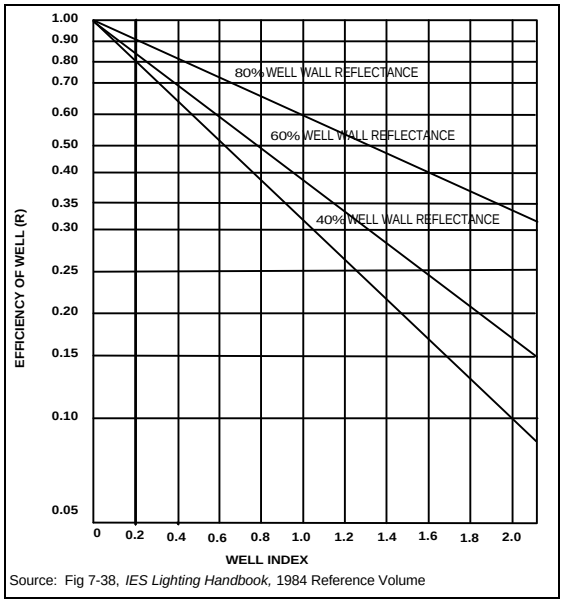
where the length, width, perimeter and area are measured at the bottom of the well.

Figure 5-6: Skylight Daylit Area



The area weighted average reflectance [of the walls of the well (R)] is the average calculated by the area of reflectance of all surfaces associated with a skylight. Reflectance is based on the surface color and type. To acquire information on the values for various surface types refer to the 1987 Illumination Engineering Society Handbook, or use the Munsell reflectance rating system. See Figure 5-7 to determine the well index.

Figure 5-7: Well Index (Efficiency of Well) Graph



Source: Fig 7-38, *IES Lighting Handbook,* 1984 Reference Volume

Example 5-7: Skylight Effective Aperture

Question

A skylight well has bottom dimensions of 6 ft by 8 ft. The well height is 4 ft. The inside surface of the well is painted with a blue paint having a reflectance of 50%. The skylight area is 16 sf. It has a visible light transmittance of 35%. The gross exterior roof area of the room is 200 sf. What is the effective aperture?

Answer

First, calculate the well index:

$$\text{Well index} = \frac{\text{Well hgt x (well length + well width)}}{\text{2 x well length x well width}}$$

$$\left(\frac{4 \text{ ft x } (8 \text{ ft} + 6 \text{ ft})}{2 \text{ x } 8 \text{ ft x } 6 \text{ ft}} \right) = 0.58$$

Next, find the well index (efficiency of well) from Figure 5-7. Enter at the bottom at 0.58. Draw a vertical line up to the 50% reflectance line (interpolate midway between the 40% and 60% Reflectance lines). From the intersection, draw a horizontal line left to find the well index of 0.56.

Then calculate the skylight-to-roof ratio of the room: 16 sf / 200 sf = 0.08.

Finally, calculate the EA by multiplying together the well index, VLT, skylight-to-roof area ratio, and dirt depreciation (0.85) and divide by the gross exterior roof area (200sf).

Skylight EA = 0.58 x 0.35 x 0.08 x 0.85/200 = .000. No daylit area controls required.

D. Shut-Off Controls (§131(d))

The Standards require that most buildings, or separately metered space greater than 5,000 square feet of conditioned space, have an automatic control to shut off the lights. Additionally, if the building has more than one floor, each floor shall have the lights on the floor controlled by a separate automatic control device (or control point if a multiple point control system).

The areas exempted from automatic shut-off are:

- Buildings or separately metered spaces less than 5,000 square feet
- Areas that must be continuously lit imply 24 hour operation, such as hotel lobbies and 24-hour, 365 day/year grocery stores where lights are never turned off.
- Areas lit in a manner requiring manual operation of the lighting system *such as* spaces which always have varying and unpredictable operating schedules, or spaces with lighting systems equipped with high intensity discharge (HID) lamps AND where the use of the space results in unpredictable on/off operation. The

space requires manual operation because of the longer start/restart time of HID lamps coupled with the unpredictable schedule.

NOTE:
Most facilities equipped with HID lighting will not fall under this exception because an operating schedule will be reasonable to predict. A facility with a predictable operating schedule and metal halide lighting could still use automatic shut-off without posing a risk to people working or conducting business in the building.

- Security or emergency egress lighting that must be continuously lit, provided it does not exceed 1/2 watt per square foot and the area is controlled by switches accessible only to authorized personnel (the security or egress area must be documented on the plans)
- Corridors, guest rooms, and lodging quarters of high-rise residential buildings or hotel/motels

The shut-off control need not be a single control, but may include automatic time switches, occupancy sensors, or other automatic controls (see Figures 5-8 and 5-9.)

When an occupant-sensing device is used to meet the automatic shut-off requirement, it is required to be installed in accordance with manufacturer's instructions with regard to placement of the sensors.

Automatic time switches with programmable solid state perpetual calendar control devices can also be used to meet the shut-off requirement. These devices are typically available with multiple channels of control, and may also be used to meet the mechanical system automatic time switch control requirements.

Figure 5-8: Timed Manual Override

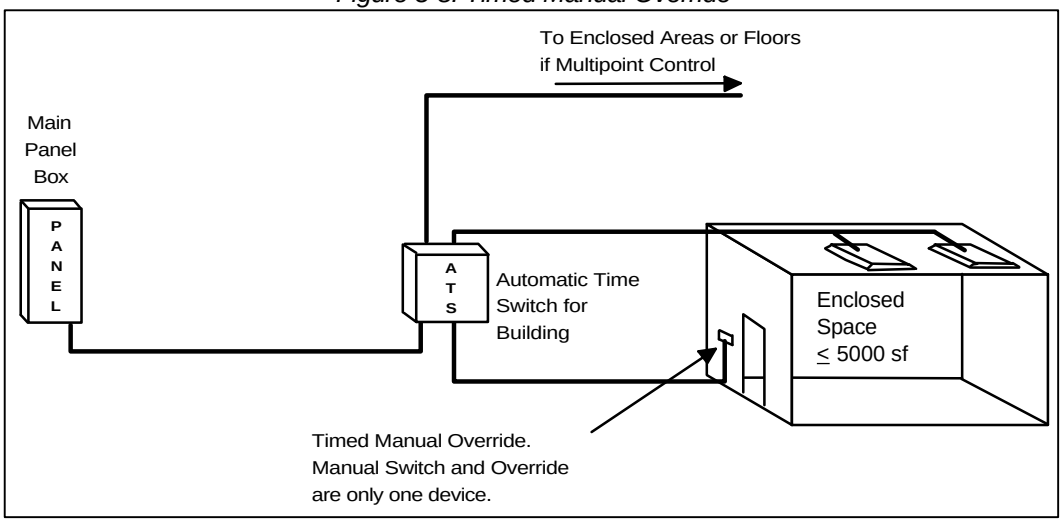
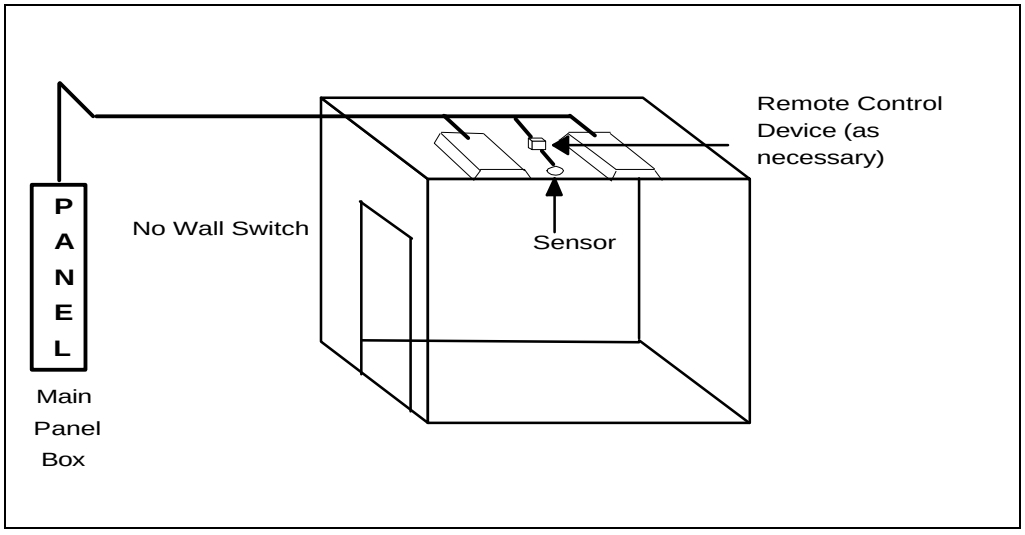


Figure 5-9: Occupant-sensing Device Shut-off



If an automatic time switch control device is used for shut-off control, it must be certified, incorporate an automatic holiday shut-off that turns off all lighting loads for at least 24 hours and then resume normal scheduled operation. Holiday scheduling is not required for: retail stores and associated malls, restaurants, grocery stores, churches, and theaters. If an automatic time switch control device is used for shut off, the control is required to be designed with override switching devices. The override switching devices shall:

- Control an area not exceeding 5,000 square feet on a single floor. For malls and arcades, auditoriums, single tenant retail spaces, industrial facilities, and arenas, the area controlled may not exceed 20,000 square feet.
- Be readily accessible
- Be manually operated

- Allow the operator to see the lights or area controlled or be annunciated (see definition in Section 5.1.2C)

- Provide an override for not more than 2 hours. In malls and arcades, auditoriums, single tenant retail spaces, industrial facilities, and arenas where captive-key override (see definition in Section 5.1.2C) is utilized, a 2 hour override limit is not required.

E. Display Lighting (§131(e))

Display lighting shall be separately switched on circuits that are 20 amps or less. The general lighting should be on separate switching so it will be operated without having to turn on the display lighting (as, for example, when the cleaning crew is working at night and there is no need for the displays to be lit).

F. Exterior Lights (§131(f))

The Standards also require automatic control of all exterior lighting that is served from a lighting panel **within** the building. The exterior lights shall be controlled by a directional photocell or an astronomical time switch that automatically turns off the exterior lighting when daylight is available. A building automation system with a program that is capable of duplicating the action of an astronomical time switch is acceptable.

When determining the type of control to use, night time ambient lighting such as street lights, sports stadiums, car headlights, etc. should be considered because they may effect the performance of a directional photocell.

Lights in parking garages, tunnels, and large covered areas that are required to be on during the day are exempt from this requirement.

G. Tandem Wiring (§132)

Pairs of one-lamp or three-lamp recessed fluorescent luminaires that are 1) on the same switch control, 2) in the same enclosed area and 3) within 10 feet of each other in an accessible ceiling space, must be tandem wired (see Figure 5-10). Single lamp ballasts should not be used.

Tandem wiring refers to the arrangement where a ballast operates a lamp in one luminaire and a lamp in an adjacent luminaire. Surface or pendant mounted fixtures that are continuous with each other must also be tandem.

Luminaires that are exempt from this requirement are:

- Surface or pendant mounted luminaires that are not continuous

- Florescent luminaires that use electronic high frequency ballasts

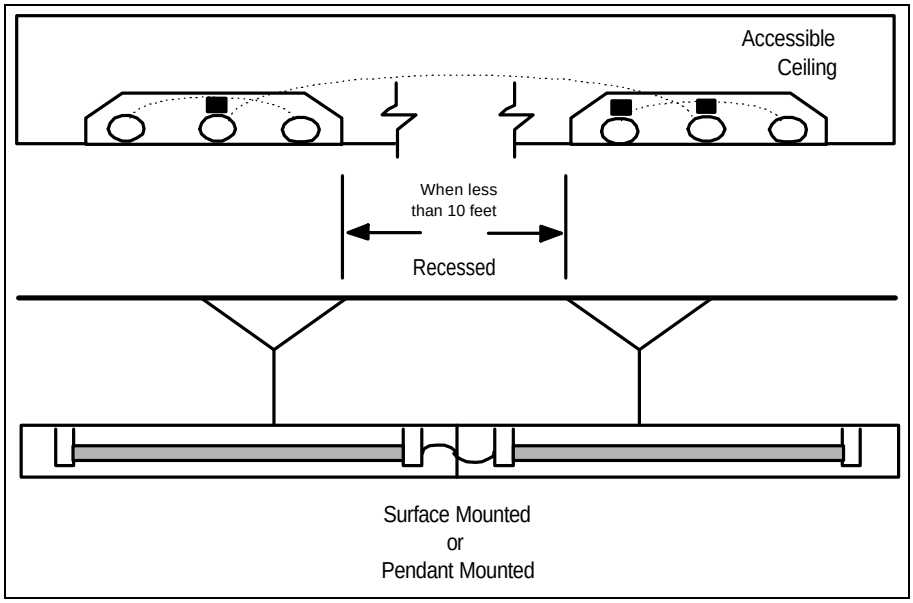
Single lamp ballasts may be used in emergency battery-ballast units and when there are an odd number of lamps or where there are multiple groups of bi-level switching and the control scheme produces two one-lamp ballasts adjacent to each other, but controlled by different switches.

Exit signs are exempt.

H. Certified Automatic Lighting Control Devices (§119)

All automatic lighting control devices must be certified by the manufacturer to the Energy Commission before they can be installed in a building. The certification of the performance of these devices to the Energy Commission is the responsibility of the manufacturer. Once a device is certified, it will be listed in the Directory of Automatic Lighting Control Devices. Call the Energy Hotline at 1-800-772-3300 to obtain more information. All devices must have instructions for installation and start-up calibration, must be installed in accordance with such directions, and must have a status signal (visual or audio) that warns of failure or malfunction. In addition, certain devices must meet the specialized requirements listed below.

Figure 5-10: Tandem Wiring



Automatic Time Switches (ATS) (§119(c))

Automatic time switches are used to automatically shut-off the lights according to pre-established schedules appropriate to the building occupants. The device is required to have separate program schedules for weekdays and weekends. To prevent losing the time of day and the programmed schedules, the time switch must contain back-up power for at least 10 hours during power interruption.

NOTE:

Most building automation systems can meet these requirements, provided they are certified to the Energy Commission.

Occupant-Sensors (§119(d))

Occupant-sensing devices shall be capable of automatically turning off all of the lights in an area no more than 30 minutes after the area has been vacated.

Additionally, the following sensors must meet special requirements.

- The ultrasonic type must meet certain minimum health requirements, and have the built-in ability for sensitivity calibration (to reduce false signals for both on and off).
- The microwave devices must have emission controls, permanently affixed installation requirements, and built-in sensitivity adjustment.

Automatic Daylighting Controls (§119(e))

Daylighting controls consist of photocell sensors that compare actual illumination levels with a reference illumination level and reduce the electric lighting until the reference level has been reached.

When automatic daylighting control devices and systems are used, they must be certified to the Energy Commission that they meet the following requirements:

- The ability to reduce the general lighting power of the controlled area by at least 50 percent uniformly (either by separate control of multiple lamps or by dimming)
- When a dimmer is used it must provide reduced flicker operation (see definitions) over the dimming range without causing premature lamp failure
- For stepped dimming, provide a minimum of 3 minutes time delay between steps to prevent cycling
- Single- or multiple-stepped switching controls with distinct on and off settings for each step shall include sufficient separation (dead-band) between points to prevent cycling
- All of the above automatic daylighting devices shall have a visual or audible signal to indicate device failure or malfunction. They shall be provided with manufacturers step-by-step installation and calibration instruction.

Lumen Maintenance Control (§119(f))

Lumen maintenance control devices and systems must meet similar requirements for Energy Commission certification as dimmed daylighting. These include reduced flicker operation, prevention of premature lamp failure, and step-by-step installation and start-up calibration instructions. Additionally, they shall be capable of reducing the general lighting in the controlled area by at least 30 percent uniformly by dimming. The system must include an alarm (either audible or visual) to indicate when a specified setpoint has been reached.

Interior Photocell (§119(g))

Both daylighting and lumen maintenance control systems incorporate a photocell that measures the amount of light at a reference location. The photocell provides light level information to the controller so it can decide when to increase or decrease the light level.

Photocell devices must be certified to the Energy Commission as not having mechanical slide covers or other means which allow easy unauthorized adjusting or disabling of the photocell. In addition, they shall not be combined in a wall mounted occupant-sensing device. (This means that wall-mounted occupant-sensing devices with photocell controls can be certified as occupant-sensing devices but not interior photocell devices.)

I. Certified Ballasts and Luminaires

Fluorescent lamp ballasts and luminaires with fluorescent lamp ballasts are regulated by the Appliance Efficiency Regulations . Those certified to the Energy Commission are listed in the Directory of Certified Luminaires and Ballasts. Call the Energy Hotline at 1-800-772-3300 to obtain more information. All standard wattage four-foot and eight-foot lamp and ballast combinations commonly installed in nonresidential buildings are included in this directory.

Detailed information on the energy efficiency standards for fluorescent lamp ballasts is available in a separate Energy Commission publication. This publication is called the Advanced Lighting Guidelines and was developed in conjunction with the Lighting Efficiency Advisory Group (LEAGue). It contains information on a variety of luminaires, lamps and ballasts that can be used to demonstrate compliance with the Standards. Appendix F has information on how to obtain these documents.

J. High Rise Residential Living Quarters and Hotel/Motel Guest Rooms (§130(b))

The Standards require that lighting in high-rise residential living quarters and in hotel/motel guest rooms comply with lighting requirements similar to the lighting requirements of the Residential Standards.

Kitchen Lighting

The Standards require that general lighting in high rise residential or hotel/motel kitchens have an efficacy of at least 40 lumens per watt and be controlled by the most accessible switch(es) in the kitchen. The light switch location determines how the occupant will use the lighting. If more than one set of light fixtures provide general lighting, those controlled by the most accessible switch are considered general lighting. Luminaries used only for specific decorative effects (and which are not the only luminaries in the kitchen) need not meet this requirement.

General lighting is lighting designed to provide a substantially uniform level of light distribution throughout a space. This can be achieved by light fixtures in the ceiling or around the perimeter of the room. Lighting fixtures under cabinets may meet the general lighting requirements if they provide uniform light distribution in the kitchen (see Figure 5-11). A luminaire which is the only lighting in a kitchen will be considered general lighting.

Bathroom Lighting

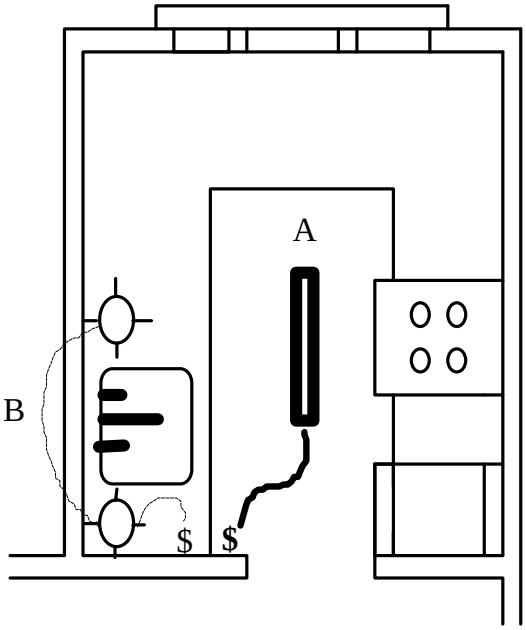
The Standards require that each room containing a water closet must have at least one luminaire with lamps with an efficacy of at least 40 lumens per watt. As an alternative, this requirement may be met by installing the high efficacy luminaire in an adjacent room that has complementary plumbing fixtures (See Figure 5-12).

If there is more than one luminaire in the room, the high-efficacy luminaire must be switched at an entrance to the room.

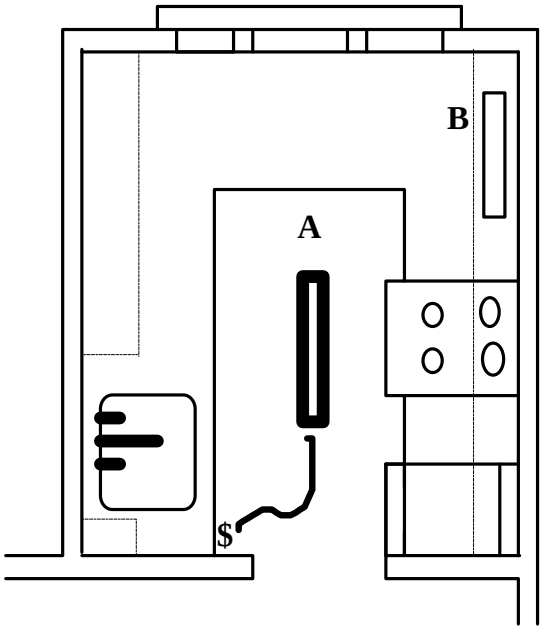
Table 5-2: Typical Efficacy of Luminaires

Light Source	Type	Rated Lamp Watts	Typical Efficacy Lumens/Watt[1]
Incandescent	Standard	40 - 100	14 - 18
Incandescent	Halogen	40 - 250	20[2]
Incandescent	Halogen IR	See footnote[3]	Up to 30
Fluorescent (Lamp/Ballast Systems)[4]	Full-Size, 4' Long	32 - 40	69 - 91
	U-Shaped T-8 Bipin	16 - 31	78 - 90
	Compact Fluorescent	5 - 9	26 - 38
	Compact Fluorescent	13 +	42 - 58
Metal Halide	Metal Halide	32 - 175	50 - 90
High Pressure Sodium	White High Pressure Sodium	35 - 100	36 - 55

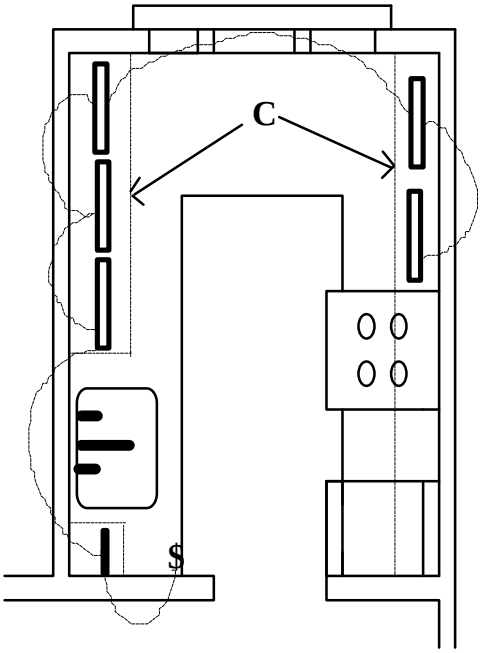
1 Includes power consumed by ballasts where applicable.
2 Halogen capsule incandescent lamps may be the most efficient light source for highlighting applications. Most halogen lamps are designed to produce a beam of directed light. Manufacturer's data typically list the "candlepower" intensity of that beam, rather than lumens (lumens measure total light output in all directions).
3 A new technology using infrared reflecting films on the halogen capsules has increased output up to 30 lumens/watt for some high wattage lamps.
4 Efficacy of fluorescent lighting varies depending on lamp and ballast types.



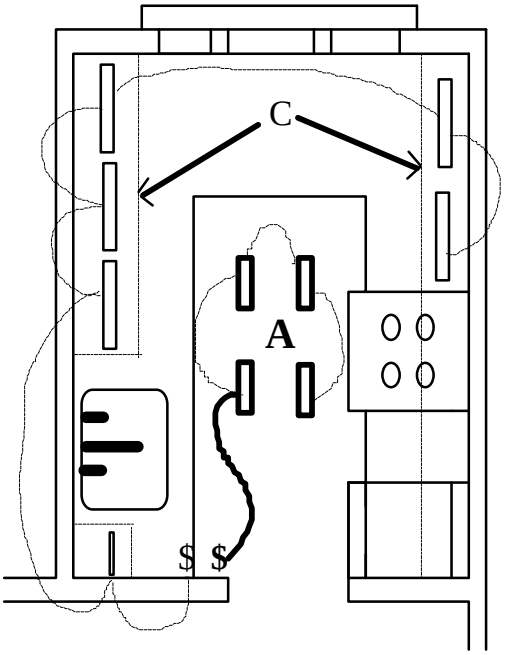
"A" must be fluorescent



"A" must be fluorescent
"B" alone is not general lighting.

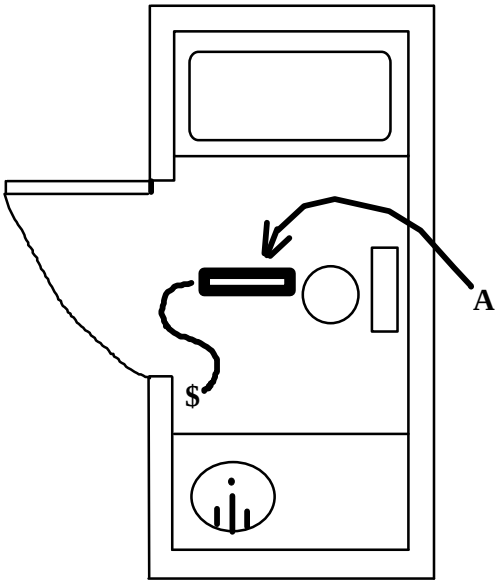


All of "C" must be fluorescent

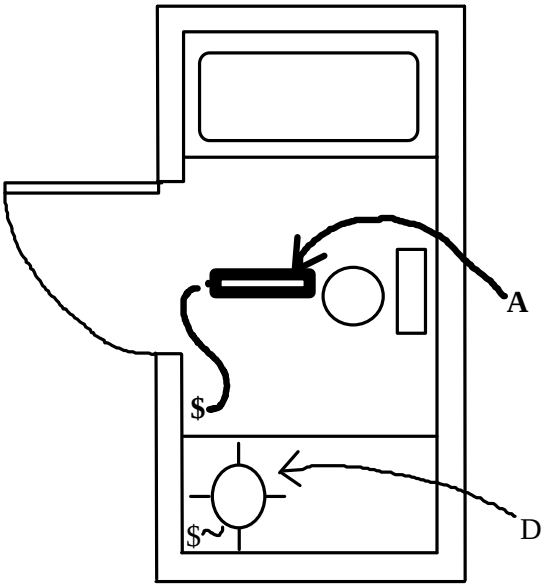


All of "A" or "C" must be fluorescent.
If "C" then "C" must be the most accessible switch.

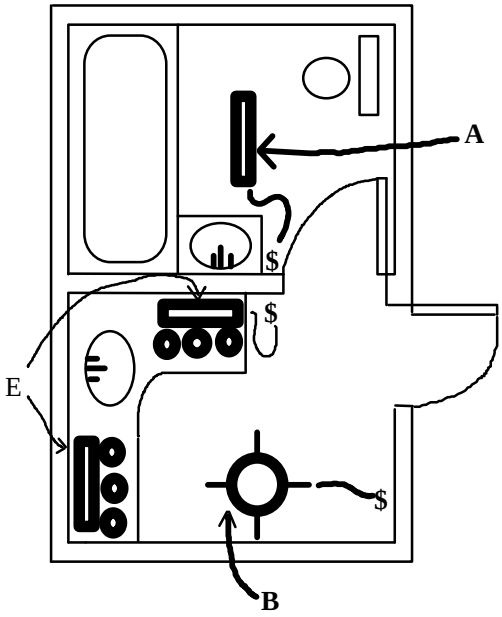
Figure 5-11: Residential and Hotel/Motel Guestroom Kitchen Lighting Examples



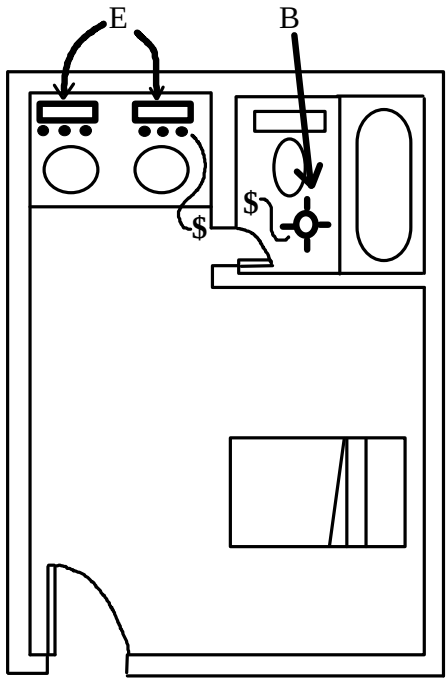
"A" must be fluorescent



"A" must be fluorescent;
"D" can be incandescent



"A", "B" or “E” must be fluorescent



"B" or "E" must be fluorescent

Figure 5-12: Residential and Hotel/Motel Guestroom
Bathroom Lighting Examples

General

Luminaries installed to meet the 40 lumens per watt requirements cannot contain medium base incandescent lamp sockets, and must be on separate switches from incandescent lighting.

All incandescent lighting fixtures recessed into insulated ceilings must be approved for zero-clearance insulation cover (I.C.) by Underwriters Laboratories or other testing/rating laboratories recognized by the International Conference of Building Officials (ICBO).

Recessed lighting fixtures left uninsulated significantly increase the heat loss and heat gain through the roof/ceiling area.

The designer has the option to exempt as many as 10 percent (by number) of the guest rooms in a hotel/motel from this requirement. This may be desirable for special consideration rooms, such as executive suites, penthouses, etc.

5.2.2 Prescriptive Approach

The prescriptive approach for lighting involves a comparison of the building's Allowed Lighting Power with its Actual Lighting Power (as adjusted). This section describes the procedures and methods for using the prescriptive approach to comply with the Standards. It incorporates common energy efficiency measures that are easily integrated into building designs.

To determine the Allowed Lighting Power using the prescriptive approach, there are three methods: the Complete Building, the Area Category and the Tailored Method.

NOTE:

The Complete Building Method can be used for tenant improvements where at least 90 percent of the permitted space is one Type of Use (which may include the following areas if they serve as support for the primary Type of Use: lobbies, corridors, restrooms and storage).

A. Allowed Lighting Power - Complete Building Method (§146(b)1)

The Complete Building Method (see Figure 5-13) of determining the Allowed Lighting Power can only be applied when all areas in the entire building are complete. The building must consist of one Type of Use for a minimum of 90 percent of the conditioned floor area (in determining the area of the primary Type of Use, include the following areas if they serve as support for the primary Type of Use: lobbies, corridors, restrooms and storage). There cannot be any unfinished areas and complete lighting plans must be submitted if any lighting wattage is being transferred from one area of the building to another. To determine the Allowed Lighting Power, multiply the complete building conditioned floor area times the lighting power density for the specific building type, as found in Table 5-3.

NOTE:

High-rise residential and hotel/motel buildings cannot use the Complete Building Method.

Table 5-3: Complete Building Method Lighting Power Density Values

Type of Use	Watts/sf.
General Commercial and Industrial Work Buildings	High 1.2 Low 1.0
Grocery Store	1.5
Industrial and Commercial Storage Buildings	0.7
Medical Buildings and Clinics	1.2
Office Building	1.2
Religious Facilities, Auditorium, and Convention Centers	1.8
Restaurants	1.2
Retail and Wholesale Store	1.7
Schools	1.4
Theaters	1.3
All Others	0.6

Example 5-8: Complete Building Method

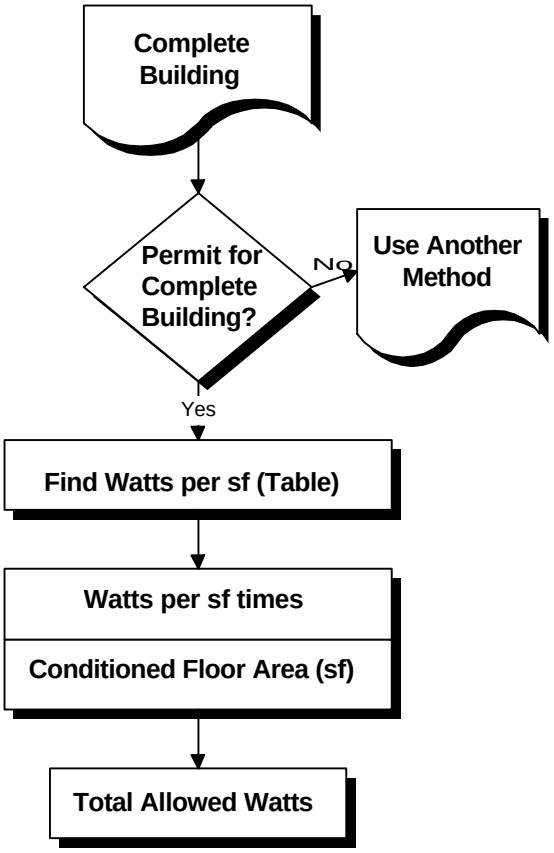
Question

A 10,000 sf Medical Clinic Building is to be built. What is its Allowed Lighting Power under the Complete Building Approach?

Answer

From Table 5-3, Medical Buildings and Clinics are allowed 1.2 watts per square foot. The Allowed Lighting Power is 10,000 x 1.2 = 12,000 watts.

Figure 5-13: Complete Building Method Flowchart



Exception to Section 146(b)2: The tailored method (Section 146(b)3) may be used for up to 10 percent of the floor area of a building that is otherwise using the area category method. The two lighting methods cannot be used for the same floor area. The floor area for calculations based on the tailored method must be subtracted from the floor area for the remainder of the building lighting calculations. Trade offs of lighting between the two methods is not allowed.

B. Allowed Lighting Power - Area Category Method (§146(b)2)

The Area Category Method is more flexible than the Complete Building Method because it can be used for multiple tenants, or partially completed, buildings. Areas not covered by the current permit are ignored. When the lighting in these areas is completed later under a new permit the applicant may show compliance with any of the lighting options except the Complete Building Method.

The Area Category Method shown in flowchart form in Figure 5-14 divides a building into primary function areas. Each function area is defined under Occupancy Type in Standards Section 101(see Section 5.1.2c.) . When using this method, each function area in the building must be included as a separate area. Boundaries between primary function areas may or may not consist of walls or partitions. For example, it is not necessary to separate aisles or entries within primary function areas. Other circumstances where a boundary between primary function areas is not defined by partitions, i.e. the kitchen and dining areas within a fast food restaurant.

Figure 5-15 shows a function area that has interior, nonbounding partitions (dotted) and bounding partitions (solid). The area is calculated by multiplying the width times the depth, as measured from the center of the bounding partitions.

The Allowed Lighting Power is determined by multiplying the area of each function times the lighting power density for that function. The Total Allowed Watts is the summation of the

Figure 5-14: Area Category Method Flowchart

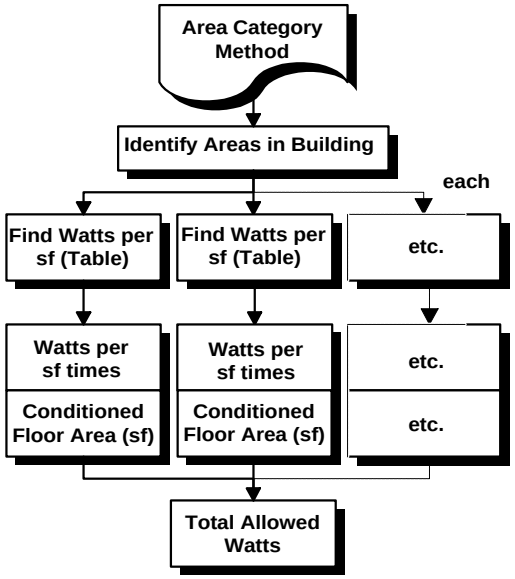
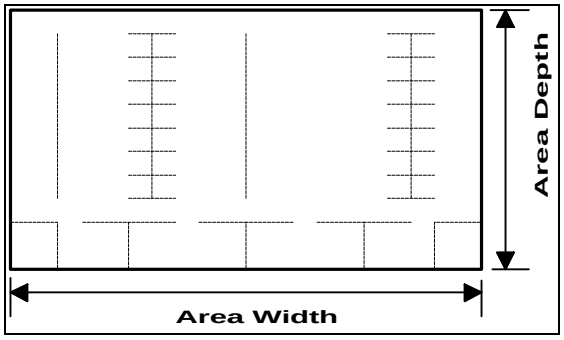


Figure 5-15: Calculating Lighting Area



Allowed Lighting Power for each area covered by the permit application. If lighting wattage is to be transferred from one area to another, this is acceptable only for areas for which lighting plans are submitted and lighting is being installed as part of the same approved permit. The Primary Function area allotments are found in Table 5-4.

Table 5-4: Area Category Method LPD Values

Primary Function	Allowed Lighting Power
All Other	0.6
Auditorium	2.0[1]
Auto Repair	1.2
Bank	1.4
Classrooms/Training	1.6
Commercial Storage	0.6
Conference Centers	1.6[1]
Convention Centers	1.6[1]
Corridors	0.6
Dining	1.1[1]
Dressing Room (Gymnasium)	0.9
Electrical Rooms	0.7
Exercise Center	1.0
Exhibit, Museum	2.0
Financial Institution	1.4
Food Preparation	1.7
General Commercial Work	
High Bay	1.2
Low Bay	1.0
General Industrial Work	
High Bay	1.2
Low Bay	1.0
Grocery Store	1.6
Gymnasium	1.0
Hotel Function Area	2.2[1]
Industrial Storage	0.6
Kitchen	1.7
Laundry	0.9
Lecture	1.6[1]
Library	
Reading Areas	1.2
Stacks	1.5
Lobbies:	
Hotel Lobby	2.2[1]
Main Entry Lobby	1.5[1]
Reception/Waiting	1.1[1]
Locker Room	0.9
Lounge/Recreation	1.1

Primary Function	Allowed Lighting Power
Malls, Arcades, and Atria	1.2[1]
Mechanical Rooms	0.7
Medical and Clinical Care	1.4
Meeting Centers	1.6[1]
Multipurpose Centers	1.6[1]
Museum Exhibit	2.0
Office	1.3
Precision Commercial Work	1.5
Precision Industrial Work	1.5
Religious Worship	2.1[1]
Restrooms	0.6
Retail Sales	2.0
Stairs	0.6
Support Areas	0.6
Theaters	
Motion Picture	0.9
Performance	1.4[1]
Vocational Room	1.6
Wholesale Showrooms	2.0

1. The smallest of the following values may be added to the allowed lighting power listed in Table No. 1-N, for ornamental chandeliers and sconces that are switched or dimmed on circuits different from the circuits for general lighting:

a. 20 watts per cubic foot times the volume of the chandelier or sconce; or
b. 1 watt per square foot times the area of the task space that the chandelier or sconce is in; or
c. the actual design wattage of the chandelier or sconce.

Chandeliers and Sconces §146(b)3H

Certain function areas use decorative lighting in the form of ornamental chandeliers or sconces. Areas shown in Table 5-4, with a reference to Footnote 1, qualify for an additional lighting allotment that may be added to the Allowed Lighting Power under the Area Category Method. Ornamental chandeliers are ceiling-mounted or suspended decorative luminaires that use glass crystal, ornamental metal or other decorative materials. Sconces are wall mounted decorative lighting fixtures.

Supplemental watts can be added to the Allowed Lighting Power to accommodate the decorative portion of the fixture.

Example 5-9: Area Category Method

Question

A 10,000 square foot multi-use building is to be built consisting of :

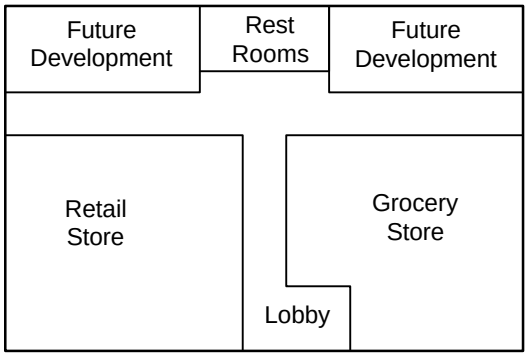
A) 500 square foot main entry lobby

B) 2,000 square foot corridors and restroom

C) 3,000 square foot grocery store

D) 2,500 square foot retail, and

E) 2,000 square foot future development



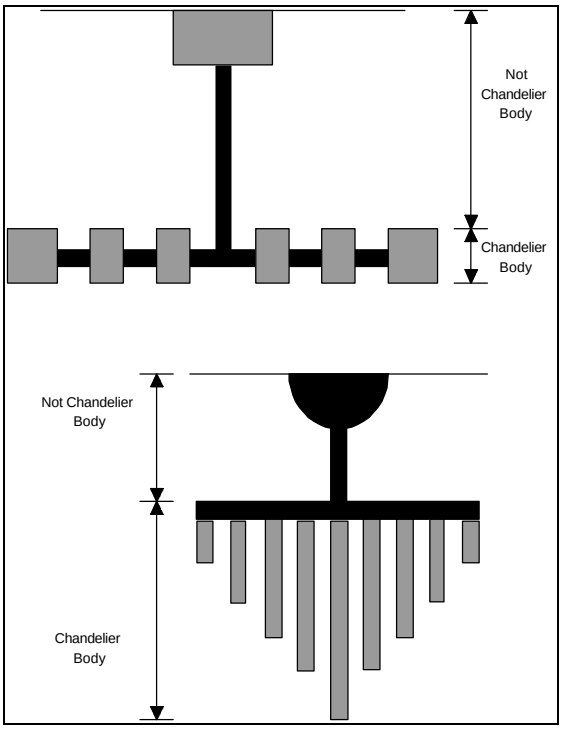
What is the Allowed Lighting Power under the Area Category Method?

Answer

A) Main Entry	1.5 w/sf	500sf	750W
B) Corridors and Restrooms	0.6 w/sf	2,000sf	1,200W
C) Grocery Store	1.6 w/sf	3,000sf	4,800W
D) Retail Store	2.0 w/sf	2,500sf	5,000W
TOTAL		8,000 sf	11,750W

with 2000 square feet for future development

Figure 5-16: Chandelier Dimensions



Example 5-10: Chandelier Wattage Allowance

Question

What is the wattage allowance for a 10 cubic foot chandelier with 5-50 watt lamps in a 300 square foot entry lobby?

Answer

The wattage based on cubic feet is 10 cf x 20 w/cf = 200 watts

The wattage based on the task space is 1 w/sf x 300 sf = 300 watts

The wattage based on actual design watts is 250 watts.

The wattage allowance for the chandelier is the smallest of the three values, or 200 watts.

C. Allowed Lighting Power - Tailored Method §146(b)3)

The maximum Allowed Lighting Power is determined for each space or activity when the Tailored Method is used. The difference between the Tailored Method and the Area Category Method, is that the Tailored Method takes into account each task activity in each enclosed space or task area as the basis for determining the lighting power allotment (as opposed to functional areas, which may have several different tasks). Because the Tailored Method is based on task activities, this method requires the most detail on the plans, and in some cases, requires documentation of the actual lighting tasks. The Tailored Method may allow more lighting power than the other two methods.

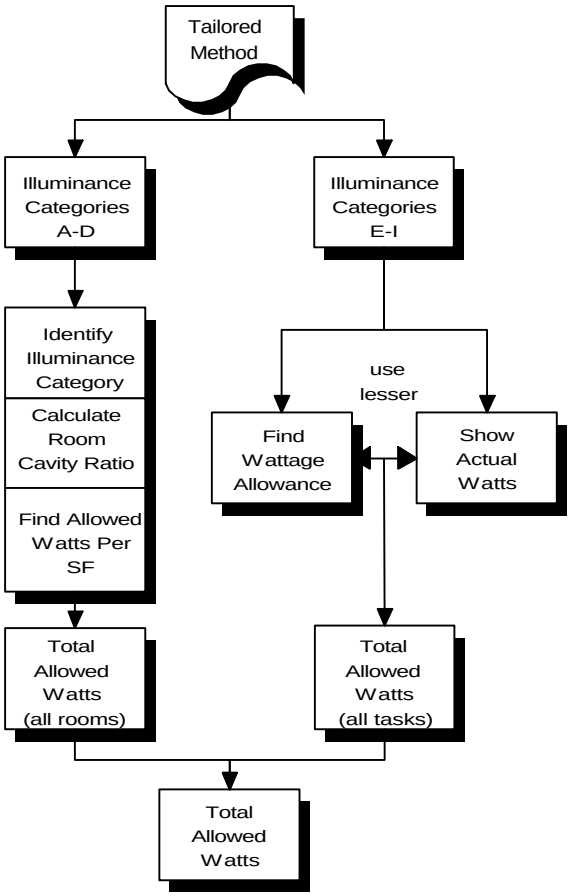
The task allotments are defined in terms of the illuminance category for each task. The Illuminating Engineering Society (IES) uses illuminance category and foot-candle levels for determining design lighting levels. Because the task allotments are based on the same categories as the IES design lighting levels, this method allows designers to translate their design parameters directly into allowed lighting power levels.

NOTE:

In many buildings the Tailored Method may actually result in less allowed lighting power than other methods. Larger allowances generally result from special lighting needs in a substantial portion of the building or from control credits.

The Tailored Method uses the process shown in Figure 5-17 for determining the Allowed Lighting Power.

Figure 5-17: Tailored Method Flowchart



Determining Illuminance Categories (§146(b)3.A)

The first step in identifying the Allowed Lighting Power when using the Tailored Method is to determine the illuminance category for each task. Illuminance categories are determined according to the task activity that will be performed. For each task, the appropriate illuminance category is found in Table B-10 (Appendix B), or in tables and procedures found in the IES Handbook, Applications Volume, 1987. Selection of each illumination category must be supported by a justification on the plans.

The Energy Commission has simplified the selection of illuminance categories for some specific types of tasks. These are listed in Table 5-5.

Illuminance categories A, B, C, and D are used for general lighting, and may be assigned within spaces without detailed supporting documentation. In fact, these categories may be used for allotments in spaces where the actual task areas are not yet defined based upon general plan designations such as: office, hallway, or rest room.

Selection of illuminance categories E through I require specific identification of the task area, as well as of the luminaires and wattages assigned to it. If it is determined from Table 5-5 or from Appendix B, Table B-10 that one of these categories applies to a particular task, then the next step is to determine the area of the task (see below).

In cases where the office lighting needs cannot be met using category D, private offices and workspaces receive a special lighting allotment based on the ANSI/IES RP-1, Office Lighting American National Standard Practice. These spaces are defined in Section 101 as follows:

Private Office or Work Area is an office bounded by 30-inch or higher partitions and is no more than 200 square feet.

Table 5-5: Illuminance Categories for Tasks

Illuminance Categories for Tasks	
Task Area	**Illuminance Category**
Churches:	
Altar, Ark, Reredos	E
Choir and Chancel	D
Main Worship Area	D
Pulpit, Rostrum	E
Dining	D
Office	D*
Public Area Displays	G
Sales Feature Displays	G
All Others	IES Handbook
*Special criteria if higher illuminance category needed (see text above).	
NOTE: All categories E and higher require consideration. See explanatory sections on following pages.	

Category E can only be applied in offices which have visually difficult tasks requiring extra illumination, and can only be used for up to 50 percent of the area of the office. The remainder of the office is calculated using 0.4 w/sf.

The criteria for determining if a task is visually difficult is based on the duration of time spent on the more difficult task. This means that the illuminance category for visual task requirements shall not be based upon an incidental task, or combination of tasks which specify the use of a given illuminance category when the incidence of these tasks totals less than two hours per working day.

A number of tasks may be visually difficult because their quality is poor. If the task quality can be improved, such tasks are not permitted to be the basis of an increased power allotment. This is especially applicable to category E tasks. The ANSI/IES RP- list the following as poor quality office tasks that are capable of being improved, and thus, do not qualify for the higher illuminance categories:

- Ditto copy, Thermal copy, poor copy and thermal printer
- Xerography, third generation and greater
- Impact printer, second carbon or later
- Typed print, second carbon or later
- Printing—6 point type
- Handwritten carbon copies
- Handwritten pencil harder than No. 2

The reason these tasks are not allowed as the basis for higher lighting levels is because efficient practices are generally available which will eliminate the higher lighting need by substituting better quality tasks. Examples of these good quality alternatives are:

- Mimeograph and xerography copy
- Impact printers with good ribbon
- Typed originals in 8 point and larger type
- Handwritten originals in No. 2 pencil or pen.

As a general rule, it is unusual for office environments other than graphic, architectural, or engineering design studios (or similar types of occupancy) to need Category E or higher illuminance levels. Applicants must provide an affidavit signed by the building owner/user that provides substantial justification for such visual “needs” and building officials should question extensive use of high level lighting requirements for common office spaces.

Example 5-11: Office Task Duration

Question

Can illuminance category "E" be used in an office because every office worker is expected to read fax transmittals and use a phone book?

Answer

This activity would not normally meet the test of two hours duration to allow use of Category “E”. However, a special business that involved reading phone books on a regular basis for most of the day could be documented and allowed the higher lighting category.

Determining LPD Values

After the illuminance category is determined, the next step is to find the lighting power density (LPD), in watts per square foot (w/sf), for each category. This depends on the illuminance category, and also on the room cavity ratio (see below) for categories A through E, Table 5-7, and upon throw distance for categories F through I, Table 5-8.

Room Cavity Ratio (RCR)

The lighting level in a room is affected by the amount of light its fixtures provide and by the configuration of the room, expressed as the Room Cavity Ratio (RCR) (definition in Section 101). Since lighting fixtures are not as effective in rooms with high RCRs, the Standards allow a greater LPD to compensate for this effect in rooms with high RCRs.

For the Tailored Method, the maximum adjusted LPD assigned to illuminance categories A through E depends on the RCR of the space.

The RCR is based on the entire space bounded by floor to ceiling partitions. If a task area within a larger space is not bounded by floor to ceiling partitions, the RCR of the entire space must be used for the task area.

The RCR is calculated from one of the following formulas:

Rectangular Shaped Rooms

$$RCR = \frac{5 \times H \times (L + W)}{L \times W}$$

Where:

RCR = The room cavity ratio.

H = The room cavity height, vertical distance measured from the work plane to the center line of the lighting fixture.

L = The room length.

W = The room width.

Non-rectangular Shaped Rooms

$$RCR = \frac{[2.5 \times H \times P]}{A}$$

Where:

RCR = The room cavity ratio.

H = The room cavity height (see equation above).

A = The room area.

P = The room perimeter.

It is not necessary to calculate RCR values for rooms with an RCR less than 3.5. Rooms with RCRs higher than 3.5 are allowed higher LPDs under the Tailored Method (see Table 5-7). Table 5-6 gives typical RCR values calculated for rooms with the task surface at desk height (2.5 ft above the floor). This table is useful in assessing whether or not a room is likely to have an RCR greater than 3.5.

The LTG-5 may be used to calculate RCR values greater than or equal to 3.5. After the RCR is determined, the LPD can be found.

Table 5-6: Typical RCRs for Flush/Recessed Luminaires (Task height 2.5 ft above floor)

Room Length (ft)	Room Width (ft)				
	8	12	16	20	24
5	8.9	7.8	7.2	6.9	6.6
8	6.9	5.7	5.2	4.8	4.6
12	. . .	4.6	4.0	3.7	3.5
16	. . .	. . .	3.4	3.1	3.0
20	. . .	. . .	. . .	2.8	2.5
24	. . .	. . .	. . .	. . .	2.3
Room Cavity Height = 5.5 ft (eight feet from floor to luminaire)					
5	12.2	10.6	9.8	9.4	9.1
8	9.4	7.8	7.0	6.6	6.3
12	. . .	6.3	5.5	5.0	4.7
16	. . .	. . .	4.7	4.2	3.9
20	. . .	. . .	. . .	3.8	3.4
24	. . .	. . .	. . .	. . .	3.1
Room Cavity Height = 7.5 ft (ten feet from floor to luminaire)					

Example 5-12: RCR Calculation

Question

A private office is 12 ft wide, by 12 ft long, by 9 ft high. The lighting system uses recessed ceiling fixtures. The task surface is at desk height (2.5 ft above the floor). What is the room cavity ratio?

Answer

The room cavity height is the distance from the ceiling (center line of luminaires) to the task surface (desk height). This is 9 ft – 2.5 ft = 6.5 ft.

RCR = [5 x H x (L + W)] / L x W

RCR = [5 x 6.5 x (12 + 12)] / (12 x 12) = 5.42

LPD for Categories A, B, C, and D

The LPD allowed for each illuminance category is determined using the room cavity ratio (RCR) and Table 5-7, which show the LPD's for illuminance categories A, B, C, D (and E). Document on LTG-4, Part 1 of 3. To calculate RCR, see above formulas.

Table 5-7: Illuminance Categories A – E

Lighting Power Density (W/sf) Illuminance Categories A-E			
Illuminance Catagories	Room Cavity Ratio		
	0 to < 3.5	>=3.5 to < 7	>=7
A	0.2	0.3	0.4
B	0.4	0.5	0.7
C	0.6	0.7	1.1
D	0.99	1.24	1.49
E	2.31	2.97	3.88
Note: Interpolation is not allowed.			

Table 5-8: Illuminance Categories F - I

Lighting Power Density (W/sf) Illuminance Categories F-I		
Illuminance Category	Task Area <= 2 sf or Throw Distance > 8 ft.	Task area > 2 sf and Throw Distance <= 8 ft.
F	9.0	4.5
G	23.4	11.7
H	56.7	29.7
I	117.0	58.5

LPD for Categories E, F, G, H, and I.

The allowed lighting power density for illuminance categories E, F, G, H and I are limited to either the value obtained in Tables 5-7 or 5-8, or the actual watts of design lighting, whichever is less. The lighting must be assigned to the task area. Adjacent non-task areas must be assigned an illuminance category between A and D.

Illuminance category E is different from categories F-I because it depends upon the RCR rather than the task area or the throw distance. In all other respects, however, these categories are treated alike. Document on LTG-4, Part 2 of 3.

The task area for each category must be determined by individual task and documented on the plans. See below for the rules and special cases for **Determining Area of a Task**.

Special Cases: General Lighting

The Allowed Lighting Power Density for library and warehouse stack type installations is based on illuminance category C for bulky item warehousing and D for library shelving. The RCR for stacks is assumed to be "7," and the appropriate LPD is found in Table 5-7. See below for an additional discussion of the determination of stack lighting area.

Neither the gross sales floor area nor the gross sales wall area for retail stores are assigned illuminance categories. Instead, these areas are assigned watts per square foot allowances.

Gross sales floor area is assigned an LPD of 2.0 watts per square foot, of associated retail area, regardless of the RCR (Section 146(b)3.D and E).

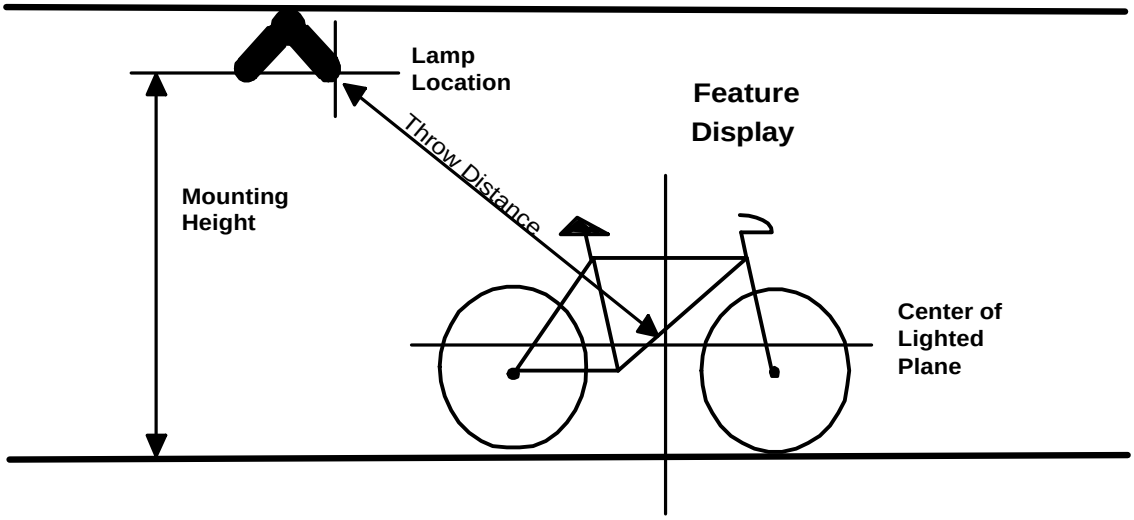
Gross sales wall area is limited to either 2.0 watts per square foot of actual wall area display, or the actual watts of design lighting, whichever is less (Section 146(b)3.D and G).

See definition of areas below in **Determining Area of a Task**.

Throw Distance. For illuminance categories F-I, the LPD allowance is higher when the throw distance from the lamp location to the display is greater than eight feet. See Figure 5-18 for an illustration of how throw distance is calculated. When there are asks illuminated by lamps with different throw distances, the shortest throw distance is used to determine the LPD allowance from Table 5-8. When track lighting is used and no fixtures are shown on the plans, the throw distance is measured perpendicular to the track from the point nearest the display.

Mounting Height. When the special circumstances of a space require that luminaires for tasks in illuminance categories A-D or E-I be mounted at a height more than 15 feet from the floor (see Figure 5-18), additional lighting power is permitted. Table 5-9 lists mounting height adjustments for various mounting heights. The appropriate multiplier is applied to the assigned LPD value from Table 5-7 or 5-8. The building department may request justification for mounting heights greater than 15 feet.

Figure 5-18: Throw Distances and Mounting Heights



When there is more than one mounting height condition, they should be separated into different task areas for purposes of applying the mounting height adjustments. The boundaries of these separate areas should be clearly shown on the plans, and the mounting height in each should also be shown with a section diagram.

Determining Area of a Task

In order to determine the Allowed Lighting Power, the task areas need to be identified. For illuminance categories A, B, C and D, the task areas are the areas of each task space that has a separate illuminance requirement. The area of each task space is determined by measuring the dimensions from inside the bounding partitions. Figure 5-19 shows a task area that has interior partitions (dotted) and bounding partitions (solid). The area is calculated by multiplying the width times the depth, as measured from the inside of the bounding partitions. The floor area occupied by the interior partitions is not included in the floor area of the function area.

Following are special rules for determining task areas in specific areas.

Office Lighting

When illuminance category E is used for private offices or work spaces, it must not be applied to more than 50 percent of the space, and the remainder of the area is allotted a 0.4 W/sf lighting power density. When Category E lighting is used, the areas must be clearly identified on the plans.

Table 5-9: Mounting Height Adjustments

Required Mounting Height	Multiplier
15 feet	1.15
16 feet	1.21
17 feet	1.47
18 feet	1.65
19 feet	1.84
20 feet or more	2.04

Example 5-13: Private Office

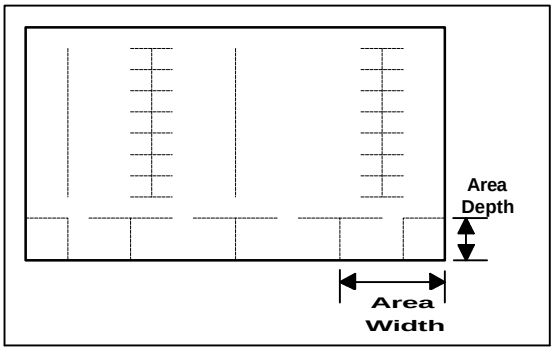
Question

The private office in Example 5-12 (RCR Calculation) is to comply under illuminance Category E. What is the Allowed Lighting Power?

Answer

The RCR is 5.4 and the area of the office is 144 sf Since 50% of the private office is allowed task E, 72 sf times 2.97 W/sf (RCR of 5.4 from Table 5-7) is 213.84 watts. The remaining private office space is calculated at 0.4 W/sf times 72 sf for a subtotal of 28.8 watts. The total Allowed Lighting Power for this space is 28.8 watts plus 213.84 watts for a total of 242.64 watts.

Figure 5-19: Calculating the Task Area



Retail and Special Display Lighting

The Tailored Method includes special provisions for retail and display lighting. The following definitions are from Standards Section 101; they are necessary to determine how the retail and display lighting provisions apply.

Display Lighting is lighting confined to the area of a display that provides a higher level of illuminance than the level of surrounding ambient illuminance.

Display, Public Areas are areas for the display of artwork, theme displays, and architectural surfaces in dining and other areas of public access, excluding restrooms and separate banquet rooms. A lighting level of Category G can be applied to these special features. This allowance cannot be used for retail applications where the highlighted feature is for sale. The public area display is the wall or floor area used for the display of artwork, theme displays, and architectural surfaces. They are limited to areas of public access, excluding restrooms and separate banquet rooms. The public area display is limited to 10 percent of the area on the plane of the display, available for each display. A space may contain both wall and floor display. Each display area must be calculated separately. These wall or floor areas are determined in a similar manner to gross sales wall or floor areas.

Display, Sales Feature is an item or items that requires special highlighting to visually attract attention and that is visually set apart from the surrounding area.

Display, Sales Feature Floor is a feature display in a retail store, wholesale store, or showroom that requires display lighting. The sales feature floor display area is confined to the actual area of display. For purposes of calculating the lighting power allowance (which is based on a Category G lighting level), this area cannot exceed 10 percent of the Gross Sales Floor Area, unless the stores gross sale area is smaller than 800 square feet in area, in which case it is permitted a Sales Feature Floor Display allowance of 1000 watts. The display areas should be clearly identified on the plans.

Display, Sales Feature Wall are the wall display areas, in a retail or wholesale space, that are in the vertical plane of permanent walls or partitions, and that are open shelving feature displays or faces of internally illuminated transparent feature display cases within the Gross Sales Wall Area. For purposes of calculating the Allowed Lighting Power, the Sales Feature Wall Display area is limited to 10 percent of the Gross Sales Wall Area at a Category G lighting level. Additionally, the areas should be clearly identified on the plans.

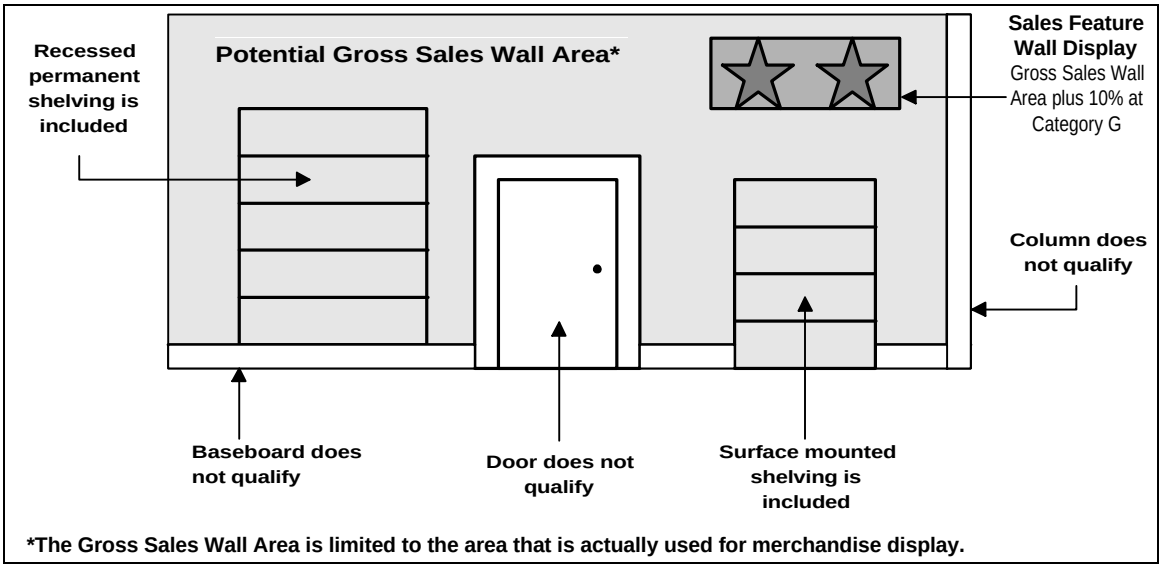
Gross Sales Floor Area is the total area (in square feet) of a retail store floor space that is (1) used for the display and sale of merchandise, or (2) associated with that function, including, but not limited to, sales transactions areas, fitting rooms and circulation areas and entry areas within the space used for display and sale. (See discussion of allotted LPD for Gross Sales Floor Area above at Special Cases: General Lighting.).

Gross Sales Wall Area is the area (in square feet) of the inside of exterior walls and permanent full height interior partitions within the gross sales floor area of a retail store that is used for the presentation of merchandise for sale, less the area of openings, doors, windows, baseboards, wainscots, mechanical or structural elements, and other obstructions preventing the use of the area for the presentation of merchandise (see Figure 5-20). The walls must be associated with the Gross Sales Floor Area. (See discussion of allotted LPD for Gross Sales Wall area above at Special Cases: General Lighting).

The Allowed Lighting Power for very valuable merchandise is 20 watts per square foot of lighted case top, or actual watts, whichever is smaller. Floor display cases, that contain jewelry and other valuable merchandise are allowed this allotment for each square foot of lighted display case counter top. To qualify for this allotment, illumination for the valuable merchandise must be provided from above the display case.

Detailed documentation should be provided on the plans that shows the placement of display cases, specific dimensions, and details of proposed lighting systems.

Figure 5-20: Gross Sales Wall Area



Library and Warehouse Stacks

A special situation occurs when illuminating stacks of shelves in libraries, warehouses, and similar spaces. In this situation, the lighting requirements are to illuminate the vertical stack rather than the horizontal floor area (see Figure 5-21). In stack areas, as discussed above, the RCR is assumed to be greater than seven. The non-stack areas are treated normally.

Example 5-14: Stack Lighting RCR

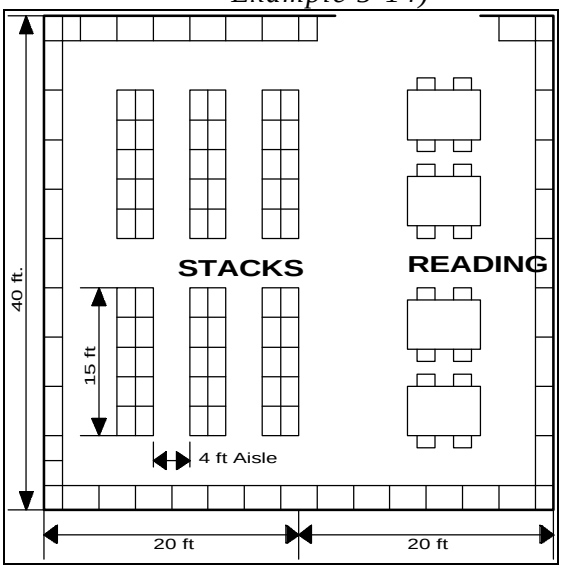
Question

How is the RCR determined for the library reading room/stack area shown in Figure 5-21

Answer

A RCR value of 7 may be assumed for the stack area. The reading area RCR is calculated based on the reading area room dimensions (20 ft x 40 ft) and on the room cavity height.

Figure 5-21: RCR for Stack Lighting (see Example 5-14)



Other Task Areas

Task areas not mentioned in the previous discussion are determined based on the actual area of each task. These other task areas must be identified on the plans submitted for permit.

Determining Allowed Watts

After the LPD and task area assigned to each space or task is established, the allowed watts may be calculated. There are two cases:

For illuminance categories A through D and for the Gross Sales Floor Area, the allowed watts are calculated simply by multiplying the LPD (watts/sf) by the area of the space (sf).

For illuminance categories E through I, Gross Sales Wall Areas and feature displays, the allowed watts are the lesser of:

a) the LPD (watts/sf) multiplied by the area of the task (sf) to obtain allotted watts, and

b) the design watts of the luminaires assigned to the task.

The sum of the allowed watts for all spaces and tasks is the building Allowed Lighting Power, in watts, as determined by the Tailored Method.

Allocation Restrictions of Task Lighting

When using the Tailored Method, the determination of task lighting is based on need. Therefore, lighting plans must be submitted that show the actual task lighting application. Task lighting allotments from walls, floors or special applications cannot be traded off for use as general lighting.

D. Simplification for Tenant Spaces

As an option, an entire tenant space can use the Complete Building Method when at least 82 percent of the permitted space is one of the primary functions listed in Table 5-4 (see Figure 5-22 and Examples 5-15 through 5-17).

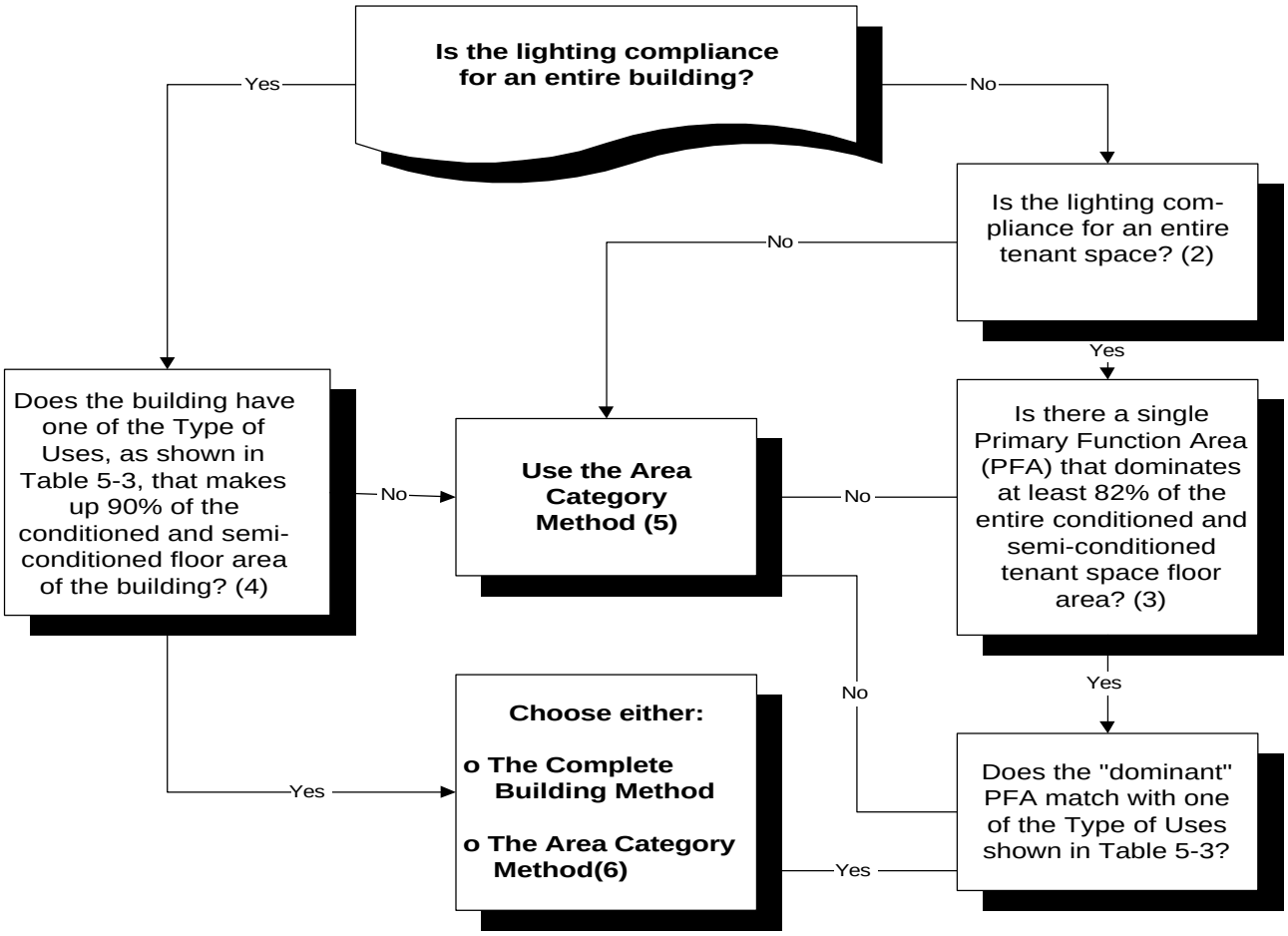
A tenant space is part of a building leased or used by a single tenant that is separated from other tenants by demising partition(s).

E. Summary

Under the prescriptive approach for lighting, one of the three methods discussed above, the Complete Building Method, the Area Category Method, or the Tailored Method, is used to determine the Allowed Lighting Power for the building. This value sets the upper limit for lighting power in the building. The next step is to calculate the Actual Lighting Power (with adjustments, if applicable). The Actual Lighting Power (adjusted) may not exceed the Allowed Lighting Power. See Section 5.2.4 for the procedures used to calculate Actual Lighting Power and its adjustments. When using Complete Building, Area Category, or Tailored Method, the lighting allotment must be based on area intended only for occupancy, or complete lighting plans must be submitted.

Figure 5-22: Lighting Power Density Calculation Flowchart

COMPLETE BUILDING METHOD AND AREA CATEGORY METHOD (1)



(1) Lighting compliance can also be achieved using the Tailored Method or the Performance Method. The lighting power portion of the Performance allowed budgets is determined by selecting the appropriate Complete Building or Area Category uses or function types, in accordance with the modeling rules shown in the flowchart above. The Tailored method may also be used to establish the lighting portion of the Performance Method allowed budget.

(2) A tenant space is a part of the building leased or used by a single entity that is separated by demising partitions from other tenants. The Complete Building Method may not be used for permits issued for partial tenant spaces. Multiple tenant spaces, when making up less than an entire building but permitted together, may each use the Complete Building Method by showing that EACH space meets the requirements of the Complete Building Method.

(3) PFA = Primary Function Area. All Primary Function Areas are listed in Table 5-4 of this Manual. The "dominant" PFA refers to the Function Area with the largest floor area among all Function Areas contained within a tenant space.

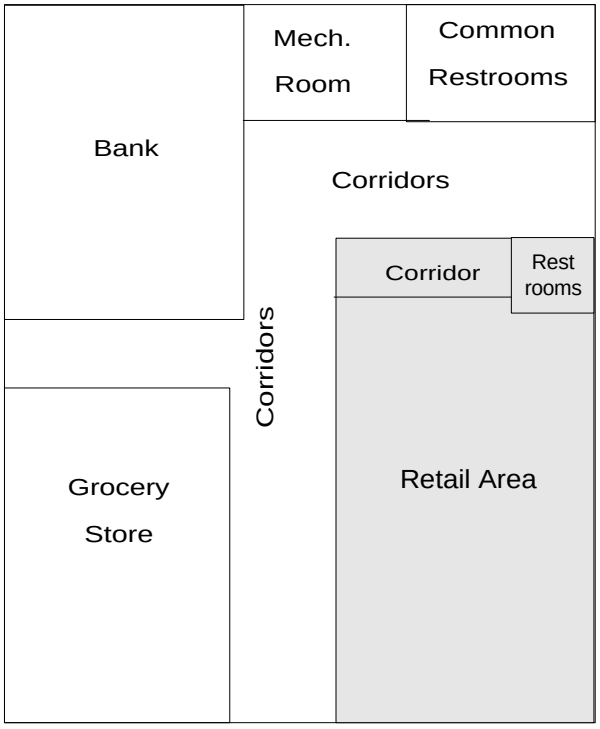
(4) Type of Use (TOU) is defined as a single type of use, as used in this Manual and listed in Table 5-3. To determine the AREA of the TOU, the following areas shall be included, provided they serve the primary use function: Lobbies, Corridors, and Restrooms.

(5) When using the Area Category Method, breakout separate Function areas into separate area categories, such as Retail Function, Corridor, Restroom, and Commercial Storage Functions.

Example 5-15: Simplified Lighting Flowchart, New Building

Question

If the figure below is a new building, what is the allowed lighting power for the entire building?



Drawing not to scale

Function	*Area*	*% Total of Area*
Non-Retail:		
Bank	*4,000*	*28%*
Grocery Store	*3,500*	*24%*
Mechanical Room	*200*	*1%*
Common Restrooms	*300*	*2%*
Common Corridors	*1,000*	*7%*
Total Non-Retail	*9,000*	*62%*
Retail:		
Retail Area	*4,700*	*32%*
Retail Restrooms	*200*	*1%*
Retail Corridors	*600*	*4%*
Total Retail	*5,500*	*38%*
Total Building	*14,500*	*100%*

Procedure

Using the flowchart in Figure 5-22:

1. Is the lighting compliance for an entire building? ***Yes***

2. Does the building have one of the Type of Uses that makes up 90 percent of the conditioned and semi-conditioned floor area of the building? ***No*** *(the largest Type of Use category is Retail which occupies 38 percent of the conditioned floor area of the entire building).*

Calculate the allowed lighting power by the Area Category Method.

Area Category Method:

Function	*Area*	*W/ft²*	*Watts*
Bank	*4,000*	*1.4*	*5,600*
Grocery Store	*3,500*	*1.6*	*5,600*
Mechanical Room	*200*	*0.7*	*140*
Common Restrooms	*300*	*0.6*	*180*
Common Corridors	*1,000*	*0.6*	*600*
Retail Function	*4,700*	*2.0*	*9,400*
Retail Restrooms	*2000*	*0.6*	*120*
Retail Corridor	*600*	*0.6*	*360*
Total Building Lighting Power			*22,000*

Answer

The allowed lighting power is 22,000 Watts

Example 5-16: Simplified Lighting Flowchart, Alteration

Question

If the figure in Example 5-15 is an existing building and the retail store is being renovated, what is the allowed lighting power for the retail store?

Procedure

Using the flowchart in Figure 5-22:

1. Is the lighting compliance for an entire building? ***No***

2. Is the lighting compliance for an entire tenant space? ***Yes***

3. Is there a single PFA that dominates at least 82 percent of the entire conditioned and semi-conditioned tenant space floor area? ***Yes*** *(The permit is for one tenant (retail store), and the retail function area is greater than 82 percent of the entire retail store (4,700/5,500 = 0.855).)*

4. Does the dominant PFA match with one of the primary Types of Uses shown in Table 5-3? ***Yes***

Calculate the allowed lighting power by either the Complete Building Method, or the Area Category Method.

Complete Building Method:

Allowed lighting power is 5,500 x 1.7 - 9,350 Watts

Area Category Method:

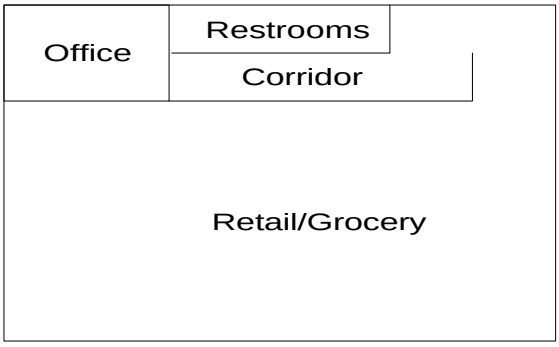
Function	*Area*	*W/ft²*	*Watts*
A) Retail	*4,700*	*2.0*	*9,400*
B) Restrooms	*200*	*0.6*	*120*
C) Retail Corridor	*600*	*0.6*	*360*
Total Allowed Lighting Power			*9,880*

Answer

The allowed lighting power is 9,350 Watts using the Complete Building Method and 9,880 Watts using the Area Category Method.

Example 5-17: Simplified Lighting Flowchart, Retail/Grocery Combination

Question
What is the allowed lighting power for the Retail Grocery store combination in the figure below?



Drawing not to scale

Function	*Area*	*% Total of Area*
Retail	*5,750*	***63%***
Grocery	*2,150*	*23%*
Retail Office	*450*	*5%*
Restrooms	*300*	***3%***
Corridors	*550*	***6%***
Total	*9,200*	*100%*
Retail Type of Use	*6,600*	*72%*

Procedure

Using the flowchart in Figure 5-22:

1. Is the lighting compliance for an entire building? ***Yes***

2. Does the building have one of the Type of Uses that makes up 90 percent of the conditioned and semi-conditioned floor area of the building? ***No*** *(There are several Primary Function Areas including retail, grocery, office, restroom and storage. However, the retail, which includes retail, restrooms and corridor functions, makes up only 72 percent of the conditioned floor area. Note that the office function is a separate Type of Use and therefore excluded from the retail Type of Use calculations.)*

Calculate the allowed lighting power by the Area Category Method.

Function	*Area*	*W/ft²*	*Watts*
Retail	*5,750*	*2.0*	*11,500*
Grocery	*2,150*	*1.6*	*3,440*
Office	*450*	*1.3*	*585*
Restrooms	*300*	*0.6*	*180*
Corridor	*550*	*0.6*	*330*
Total Allowed Lighting Power			*16,035*

Answer

The allowed lighting power is 16,035 Watts.

5.2.3 Performance Approach

The performance approach provides an alternative method to the prescriptive approach for establishing the Allowed Lighting Power for the building.

Under the performance approach, the energy use of the building is modeled using a computer program approved by the Energy Commission using rules published in the Alternative Calculation Method (ACM) Manual. In this energy analysis, the standard lighting power density for the building is determined by the computer program based on occupancy type, in accordance with the Complete Building, Area Category, and Tailored rules described above(see Section 6.1 for details). This standard lighting power density is used to determine the energy budget for the building.

When a lighting permit is sought under the performance approach, the applicant uses a proposed lighting power density to determine whether or not the building meets the energy budget. If it does, this proposed lighting power density is automatically translated into the Allowed Lighting Power for the building (by multiplying by the area of the building).

If the building envelope or mechanical systems are included in the performance analysis (because they are part of the current permit application), then the performance approach allows energy trade-offs between systems that can let the Allowed Lighting Power go higher than any other method. Alternatively, it allows lighting power to be traded away to other systems, which would result in a lower Allowed Lighting Power. This flexibility in establishing Allowed Lighting Power is one of the more attractive benefits of the performance approach.

When tailored lighting is used to justify increases in the lighting load, a lower lighting load cannot be modeled for credit. The standard design building uses the lesser of allowed watts per square foot, or actual lighting power, to be installed in the building. The proposed design building uses the actual lighting power to be installed as detailed on the lighting plans. This value must be equal to, or greater than, the allowed watts per square foot.

When the Performance Approach is used, the LTG-2: Performance Approach form, or a similar form produced by an approved computer method, must be included in the compliance submittal. Refer to Section 6.1 for a more complete description of the treatment of lighting systems under the performance approach.

5.2.4 Actual Lighting Power (Adjusted)

Once the Allowed Lighting Power is determined by one of the prescriptive or performance approach, it can be compared to the Actual Lighting Power (adjusted) in the building design. The designed or Actual Lighting Power is simply the sum of the wattages of all of the lighting fixtures in the building, based on the same conditioned floor area as was used to calculate the Allowed Lighting Power.

The Actual Lighting Power may be adjusted through lighting control credits if optional automatic lighting controls are installed.

The Actual Lighting Power does not necessarily include every light in the building. There are a number of lighting applications that are exempted from the Standards limits on lighting power.

A. Exempt Lighting (§146(a)3)

The lighting applications which are exempted from the Actual Lighting Power calculation are listed below:

A. Lighting for theme parks and special effects lighting for dance floors;

B. Lighting for film studios;

C. Lighting for exhibits or for theatrical and other live performances, in exhibit, convention areas, and in hotel function areas, if the lighting is an addition to a general lighting system, and if the lighting is controlled by a multi-scene or theatrical cross-fade control station accessible only to authorized operators;

D. Specialized local lighting installed in non-lighting equipment by its manufacturer (this includes all decorative neon lighting and all signs with interior lighting);

E. In medical and clinical buildings, examination and surgical lights, low-level night lights, and lighting integral to medical equipment;

F. In restaurant buildings and areas, lighting for food warming or integral to food preparation equipment;

G. Interior lighting in refrigerated cases;

H. Lighting for plant growth or maintenance, if it is equipped with an automatic 24-hour time switch that has program backup capabilities that prevent the loss of the switch's program and time setting for at least 10 hours if power is interrupted;

I. Lighting equipment that is for sale;

J. Lighting demonstration equipment in lighting education facilities;

K. Lighting that is required for exit signs subject to Section 1012 of the UBC, if it has an efficacy of at least 40 lumens per watt and has a power factor greater than 90 percent;

L. Exit way or egress illumination that is normally off and that is subject to Section 1013 of the UBC;

M. Exit way or egress lighting whose switching is regulated by Article 3-700 of the State Electrical Code (Title 24, Part 3);

N. In hotel/motel buildings, lighting in guest rooms;

O. In high-rise residential buildings, lighting in living quarters;

P. The lighting system using the least wattage in a redundant lighting system interlocked or otherwise controlled to prohibit simultaneous operation of more than one lighting system.

Hard-wired neon lighting in signs is exempt.

B. Actual Lighting Power Calculation (§146(a))

The calculation of Actual Lighting Power is accomplished with the following steps:

1. Determine the watts for each type of fixture. This includes both the lamp and the ballast wattage. These are interdependent, so the wattage of a particular lamp/ballast combination is best determined from reputable manufacturer's test data. Default values from Table B-11 in Appendix B may be used for standard lamp and ballast combinations.

2. Determine the number of each fixture type in the design.

3. Multiply the fixture wattages by the numbers of fixtures and sum to obtain the building total Actual Lighting Power in watts.

4. Adjust for lighting control credits, if applicable (see Section 5.2.4C).

For most fixture types, this calculation is straight-forward. There are, however, a few types that require special consideration. Neon lighting that is included in the calculation of lighting power must use the transformer wattage. Track lighting and incandescent lighting must follow the guidelines below:

1. Track Lighting

Track lighting presents a special situation when calculating Actual Lighting Power, because the number and type of luminaries can be easily changed at any time. To calculate the wattage for track lights on standard voltage tracks, two values need to be determined: (a) the total luminaries wattage proposed to operate on each track; and (b) 45 watts per foot, which is 50 percent of the lighting power rating (watts) of the track by the National Electric Code (90 watts per foot). The wattage used in the calculation of Actual Lighting Power must be the larger of these two values.

Tracks serviced through permanent, installed transformers for low voltage lighting may use the volt ampere (VA) rating of the transformer as the Actual Lighting Power of the track.

Standard voltage tracks equipped with current limiters may use the actual volt-ampere (VA) rating of the current limiter as the Actual Lighting Power of the track, if:

- The current limiter is an integral part of the track and can only be replaced by manufacturer authorized technicians; and
- The VA rating of the current limiter is clearly marked on the track and is readily available for the building officials' field inspection without opening the fixture or panels.

Tracks serviced through permanent installed transformers for low voltage lighting may use the volt ampere (VA) rating of the transformer as the Actual Lighting Power of the track.

In some situations, extra length of track is desired to provide greater flexibility in locating lighting fixtures. In these cases, the designer can limit the Actual Lighting Power by providing interlock switching that limits the circuits (and therefore the electric capacity) of track lighting that can be operated simultaneously.

Track lighting for use in exhibit areas (museums, exhibit center lighting for exhibits, etc.) that meet the requirements of the exempt lighting listed in Section 5.2.4A (Item C. in list) is considered exempt lighting.

Example 5-18: Track Lighting Power

Question

What is the wattage of a six foot length of track lighting that has three 150 watt listed fixtures with 60 watt, medium base lamps proposed?

Answer

- Based on medium base socket fixtures the total wattage is 225 watts (three fixtures at 150 listed watts each times 50 percent.) See Example 5-19.
- Based on the length of track the wattage is 270 watts (6 ft x 45 w/ft).

The Actual Lighting Power of the track is the larger of the two, or 270 watts.

2. Incandescent Medium Base Sockets

Medium base sockets are typically found in fixtures that require a screw-in type lamp. They are the most common lamp base for incandescent lamps (the ordinary type of light bulb that generates light from a glowing filament), and the bases are used for a wide range of lamp wattages. These fixtures present a special situation when calculating Actual Lighting Power, because the wattage of the lamps can be easily changed at any time. To calculate the wattage for medium base fixtures, two values need to be compared: (a) the total lamp wattage proposed for the fixture, and (b) 75 watts per fixture. The wattage used in the calculation of Actual Lighting Power must be the larger of these two values.

Example 5-19: Medium Base Fixture Lighting Power

Question

What is the Actual Lighting Power of a medium base fixture, with a 60 watt lamp installed?

Answer

Based on the larger of 75 watts, or the proposed lamp (60 watts), the Actual Lighting Power is 75 watts.

Standard voltage incandescent medium base socket fixtures equipped with current limiters may use the actual volt-ampere (VA) rating of the current limiter as the Actual Lighting Power of the fixture, if:

- The current limiter is an integral part of the fixture and can only be replaced by manufacturer authorized technicians; and
- The VA rating of the current limiter is clearly marked on the fixture and is readily available for the building officials' field inspection without opening the fixture or panels.

C. Automatic Lighting Control Credits (§146(a)2)

The watts of connected lighting within the building may be adjusted to take credit for the benefits of certain types of automatic lighting controls. A list of the controls that qualify for these credits is shown in Table 5-10.

The lighting control credits reduce the Actual Lighting Power, giving a lower adjusted lighting power. This makes it easier to meet the Allowed Lighting Power requirement.

Automatic lighting controls can reduce the amount of energy used for lighting; a credit is permitted when the control types indicated in Table 5-10 are used. See also Section 5.1.2C.

In order to qualify for the power savings adjustment, the control system or device must be certified (see Section 5.2.1D), and must control all of the fixtures for which credit is claimed. At least 50 percent of the light output of the controlled luminaire must fall within the applicable type of space listed in Table 5-10. Additionally, credits may not be combined, with the exception of those listed as Combined Controls in Table 5-10 on the following page. Daylighting control credits are only available for luminaries within daylit zones, as defined in Section 5.2.1 of this manual.

5.2.5 Alterations

When altering lighting component(s) in an existing conditioned building, compliance requirements vary with the details and extent of the alterations. Some or all mandatory measures may apply, and compliance with current lighting requirements (watts/sf) may also apply. The mandatory requirements include certification of any new lamps and ballasts that are installed if they are the type regulated by the Appliance Efficiency Regulations. Any new lighting controls must meet minimum performance requirements. In addition, control and circuiting requirements (Sections 131 and 132) apply as follows:

- Independent switching within a space or room is required if ceiling height partitions are installed or moved, creating a new enclosed space.
- Bi-level illumination requirements apply if the alteration consists of rewiring and any individual enclosed space within the altered area exceeds 100 square feet and has more than 1.2 watts per square foot.
- Separate switching for daylit areas is required if the alteration involves rewiring and any individual enclosed space within the altered area exceeds 250 square feet (see **Daylit Areas**, Section 5.2.1C).
- Shut-off control requirements apply if the area in which the lighting alteration is occurring exceeds 5,000 square feet. The altered area is the area lit by the particular fixture(s) being altered. For general distribution lighting, determine the area lit using the skylight/daylit area approach (see Example 5-6). For task lighting, the area lit is expected to be narrower.
- Tandem wiring is required if the alteration involves rewiring.

NOTE:

There are exceptions and alternative methods of complying with each of these sections. For more information, refer to Section 5.2.1.

If an alteration involves replacing more than 50 percent of the lighting fixtures or results in an increase in the connected lighting load, compliance with current Standards for wattage levels is also required. When it is necessary to calculate the existing wattage to demonstrate that the alteration does not result in an increased lighting level, use the same methodology used for new lighting installations found in this section. Document both "existing" and "new" lighting power on form LTG-2.

Only those areas affected by the alteration are included in documentation. Unaltered lighting does not need to meet any requirements of the

Table 5-10: Power Savings Adjustments for Lighting Controls

Type of Control	Type of Spaces	Lighting Adjustment Factor
Occupant Sensor		
With separate sensor for each space	Any space < or = 250 sq. ft. enclosed by an opaque ceiling to floor partition; any size classroom, corridor, conference or waiting room	0.20
	Rooms of any size that are used exclusively for storage	0.60
	Rooms > 250 sq. ft.	0.10
Dimming System		
Manual	Hotels/motels, Restuarants, Auditoriums, Theaters	0.10
Multi-scene Programmable	Hotels/motels, Restuarants, Auditoriums, Theaters	0.20
Lumen Maintenence Controls	Any Space	0.05
Tuning	Any Space	0.10
Automatic Time Switch Control Device	Room < 250 sq.ft. and with timed manual override at each switch location required by §131(a), and controlling only the lights in the area enclosed by ceiling-height partitions	0.05
Combined Controls		
Occupant sensor with a separate sensor for each space used in conjuction with lumen maintenence controls	Any space < or = 250 sq.ft. and enclosed by opaque ceiling to floor partitions	0.25
Occupant sensor with programmable multi-scene dimming system	Hotels/motels, Restuarants, Auditoriums, Theaters	0.35
Occupant sensor with a separate sensor for each space used in conjunction with daylighting controls, and separate sensor for each space	Any space < or = 250 sq. ft. within a daylit area and enclosed by opaque ceiling to floor partitions	0.10*

*May be added to daylighting control credits

Daylighting Controls:			
	Window-Wall		
Glazing	< 20% to	>	
VLT > or =	0.20/0.3	0.30/0.4	0.40/0.4
VLT 35% to	0/0	0.20/0.3	0.30/0.4
VLT <	0/0	0/0	0.20/0.4

Daylighting Controls:			
	% of Gross Exterior		
Glazing	<	1% to	>3
VLT > or =	0/0.3	0.15/0.4	0.30/0.4
VLT 35% to	0/0.2	0/0.3	0.15/0.4
VLT <	0/0.1	0/0.2	0/0.3

Note: Two numbers are given in the daylighting control tables, e.g. 0.20/0.30. The stepped controls, which turn lamps on and off. The second number is for dimming output continuously rather than in steps (Section 119(e)).

Standards. The basis for determining if more than 50 percent of fixtures are being replaced is the permitted space (not the building space).

NOTE: See 5.2.2.D. *Simplification for Tenant Spaces for circumstances under which the complete building method may be used for alterations.*

Semi-Conditioned Building: In an existing semi-conditioned space, the lighting alteration requirements for conditioned buildings shall apply. When a space is unconditioned and is converted to semi-conditioned no requirements apply. If an unconditioned or semi-conditioned building is conditioned then lighting, envelope and mechanical requirements for additions shall apply (see Section 2.2).

Semi-Conditioned Space is an enclosed nonresidential space that is provided with wood heating, cooling by direct or indirect evaporation of water, mechanical heating that has a capacity of 10 Btu/(hr ft^2) or less, mechanical cooling that has a capacity of 5 Btu/(hr ft^2)or less, or is maintained for a process environment as set forth in the Standards definition of DIRECTLY CONDITIONED SPACE (§101).

5.3 LIGHTING PLAN CHECK DOCUMENTS

At the time a building permit application is submitted to the building department, the applicant also submits plans and energy compliance documentation. This section describes the recommended forms and procedures for documenting compliance with the lighting requirements of the Standards. It does not describe the details of the requirements; these are presented in Section 5.2, Lighting Design Procedures. The following discussion is addressed to the designer preparing construction documents and compliance, and to the building department plan checkers who are examining those documents for compliance with the Standards.

The use of each form is briefly described below, then complete instructions for each form are presented in the following subsections. These forms may be included in the lighting equipment schedules on the plans, provided the information is in a similar format as the suggested form.

LTG-1: Certificate of Compliance

This form is required for every job, and it is required to appear on the plans.

LTG-2: Lighting Compliance Summary

This form is required for all submittals.

LTG-3: Lighting Controls Credit Worksheet

This form should only be required when calculating control credit watts.

LTG-4: Tailored LPD Summary and Worksheet

This form should only be required when calculating the Allowed Lighting Power using the Tailored Method. Part 1 should be submitted whenever this method is used, part 2 is used for Illuminance Categories E through I, and part 3 is used for display lighting.

5.3.1 LTG-1: Certificate of Compliance

The LTG-1 Certificate of Compliance form is in two parts. Both parts must appear on the plans (usually near the front of the electrical drawings). A copy of these forms should also be submitted to the building department along with the rest of the compliance submittal at the time of building permit application. With building department approval, the applicant may use alternative formats of these forms (rather than the official Energy Commission forms), provided the information is the same and in a similar format.

A. LTG-1 Part 1of 2

Project Description

PROJECT NAME is the title of the project, as shown on the plans and known to the building department.

DATE is the date of preparation of the compliance submittal package. It should be on or after the date of the plans, and on or before the date of the building permit application.

PROJECT ADDRESS is the address of the project as shown on the plans and as known to the building department.

PRINCIPAL DESIGNER - LIGHTING is the person responsible for the preparation of the lighting plans, one of two people who sign the STATEMENT OF COMPLIANCE (see below). The person's telephone number is given to facilitate response to any questions that arise.

DOCUMENTATION AUTHOR is the person who prepared the energy compliance documentation. This may or may not be the principal designer (it may be a person specializing in energy standards compliance work). This person is not subject to the Business and Profession's Code. The person's telephone number is given to facilitate response to any questions that arise.

ENFORCEMENT AGENCY USE is reserved for building department record keeping purposes.

General Information

DATE OF PLANS is the last revision date of the plans. If the plans are revised after this date, it may be necessary to resubmit the compliance documentation to reflect the altered design. The building department will determine whether or not the revisions require this.

BUILDING CONDITIONED FLOOR AREA has specific meaning under the Standards. Refer to Section 2.1.2A for a discussion of this definition.

The number entered here should match the floor area entered on form ENV-1

CLIMATE ZONE of the building. Refer to Appendix C.

BUILDING TYPE is specified because there are special requirements for high-rise residential and hotel/motel guest room occupancies. All other occupancies that fall under the Nonresidential Standards are designated "Nonresidential" here. It is possible for a building to include more than one building type. See Section 2.1.2B for the formal definitions of these occupancies.

PHASE OF CONSTRUCTION indicates the status of the building project described in the documents. Refer to Section 2.2 for detailed discussion of the various choices.

a. **NEW CONSTRUCTION** should be checked for all new buildings (see Section 2.2.6), newly conditioned space (see Section 2.2.2) or for new construction in existing buildings (tenant improvements, see Section 2.2.3) which are submitted for envelope compliance.

b. **ADDITION** should be checked for an addition which is not treated as a stand-alone building, but which uses Option 2 described in Section 2.2.5 Additions.

c. **ALTERATION** should be checked for alterations to existing building lighting systems. See Section 2.2.4.

METHOD OF LIGHTING COMPLIANCE indicates which method is being used and documented with this submittal:

a. COMPLETE BUILDING should be checked if the lighting system complies using the complete building method, as documented on the LTG-2 Form

b. AREA CATEGORY should be checked if the area category method, as documented on the LTG-2 form

c. TAILORED should be checked if the tailored method of lighting compliance, with supporting documentation (LTG-2 and LTG-4) is submitted.

d. **PERFORMANCE** should be checked when the performance method is used to show compliance. All required performance documentation must be included in the plan check submittal when this method is used.

Statement of Compliance

The Statement of Compliance is signed by the person responsible for preparation of the plans for the building. This person is also responsible for the energy compliance documentation, even if the actual work is delegated to someone else (the Documentation Author described above). It is necessary that the compliance documentation be consistent with the plans. The Business and Professions Code governs who is qualified to prepare plans, and therefore to sign this statement; check the appropriate box that describes the signer's eligibility.

Applicable sections from the Business and Professions Code (based on the edition in effect as of April 1998), referenced on the Certificate of Compliance, are provided below:

5537. *(a) This chapter does not prohibit any person from preparing plans, drawings, or specifications for any of the following:*

(1) Single-family dwellings of woodframe construction not more than two stories and basement in height.

(2) Multiple dwellings containing no more than four dwelling units of woodframe construction not more than two stories and basement in height. However, this paragraph shall not be construed as allowing an unlicensed person to design multiple clusters of up to four dwelling units each to form apartment or condominium complexes where the total exceeds four units on any lawfully divided lot.

(3) Garages or other structures appurtenant to buildings described under subdivision (a), of woodframe construction not more than two stories and basement in height.

(4) Agricultural and ranch buildings of woodframe construction, unless the building official having jurisdiction deems that an undue risk to the public health, safety, or welfare is involved.

(b) If any portion of any structure exempted by this section deviates from substantial compliance with conventional framing requirements for woodframe construction found in the most recent edition of Title 24 of the California Code of Regulations or tables of limitation for woodframe construction, as defined by the applicable building code duly adopted by the local jurisdiction or the state, the building official having jurisdiction shall require the preparation of plans, drawings, specifications, or calculations for that portion by, or under the responsible control of, a licensed architect or registered engineer. The documents for that portion shall bear the stamp and signature of the licensee who is responsible for their preparation. Substantial compliance for purposes of this section is not intended to restrict the ability of the building officials to approve plans pursuant to existing law and is only intended to clarify the intent of Chapter 405 of the Statutes of 1985.

5537.2. *This chapter shall not be construed as authorizing a licensed contractor to perform design services beyond those described in Section 5537 or in Chapter 9 (commencing with Section 7000), unless those services are performed by or under the direct supervision of a person licensed to practice architecture under this chapter, or a professional or civil engineer licensed pursuant to Chapter 7 (commencing with Section 6700) of Division 3, insofar as the professional or civil engineer practices the profession for which he or she is registered under that chapter.*

However, this section does not prohibit a licensed contractor from performing any of the services permitted by Chapter 9 (commencing with Section 7000) of Division 3 within the classification for which the license is issued. Those services may include the preparation of shop and field drawings for work which he or she has contracted or offered to perform, and designing systems and facilities which are necessary to the completion of contracting services which he or she has contracted or offered to perform.

However, a licensed contractor may not use the title "architect," unless he or she holds a license as required in this chapter.

5538. *This chapter does not prohibit any person from furnishing either alone or with contractors, if required by Chapter 9 (commencing with Section 7000) of Division 3, labor and materials, with or without plans, drawings, specifications, instruments of service, or other data covering such labor and materials to be used for any of the following:*

(a) For nonstructural or nonseismic storefronts, interior alterations or additions, fixtures, cabinetwork, furniture, or other appliances or equipment.

(b) For any nonstructural or nonseismic work necessary to provide for their installation.

(c) For any nonstructural or nonseismic alterations or additions to any building necessary to or attendant upon the installation of those storefronts, interior alterations or additions, fixtures, cabinetwork, furniture, appliances, or equipment, provided those alterations do not change or affect the structural system or safety of the building.

6737.1. *(a) This chapter does not prohibit any person from preparing plans, drawings, or specifications for any of the following:*

(1) Single-family dwellings of woodframe construction not more than two stories and basement in height.

(2) Multiple dwellings containing no more than four dwelling units of woodframe construction not more than two stories and basement in height. However, this paragraph shall not be construed as allowing an unlicensed person to design multiple clusters of up to four dwelling units each to form apartment or condominium complexes where the total exceeds four units on any lawfully divided lot.

(3) Garages or other structures appurtenant to buildings described under subdivision (a), of woodframe construction not more than two stories and basement in height.

(4) Agricultural and ranch buildings of woodframe construction, unless the building official having jurisdiction deems that an undue risk to the public health, safety or welfare is involved.

(b) If any portion of any structure exempted by this section deviates from substantial compliance with conventional framing requirements for woodframe construction found in the most recent edition of Title 24 of the California Administrative Code or tables of limitation for woodframe construction, as defined by the applicable building code duly adopted by the local jurisdiction or the state, the building official having jurisdiction shall require the preparation of plans, drawings, specifications, or calculations for that portion by, or under the direct supervision of, a licensed architect or registered engineer. The documents for that portion shall bear the stamp and signature of the licensee who is responsible for their preparation.

6737.3. *A contractor, licensed under Chapter 9 (commencing with Section 7000) of Division 3, is exempt from the provisions of this chapter relating to the practice of electrical or mechanical engineering so long as the services he or she holds himself or herself out as able to perform or does perform, which services are subject to the provisions of this chapter, are performed by, or under the responsible supervision of a registered electrical or mechanical engineer insofar as the electrical or mechanical engineer practices the branch of engineering for which he or she is registered.*

This section shall not prohibit a licensed contractor, while engaged in the business of contracting for the installation of electrical or mechanical systems or facilities, from designing those systems or facilities in accordance with applicable construction codes and standards for work to be performed and supervised by that contractor within the classification for which his or her license is issued, or from preparing electrical or mechanical shop or field drawings for work which he or she has contracted to perform. Nothing in this section is intended to imply that a licensed contractor may design work which is to be installed by another person.

Lighting Mandatory Measures

This portion requests the location of notes clarifying the inclusion of the mandatory requirements. Notes should be included on the plans to demonstrate compliance with mandatory requirements of the Standards*.*

Following are prototype examples of the notes that should be rewritten to actual conditions. A note for each of the items listed should be included, even if the note states "not applicable".

Example 5-20: Sample Notes: Lighting Mandatory Measures

- **Building Lighting Shut-off**

  The building lighting shut-off system consists of an automatic time switch, with a zone for each floor: or

  the building is separately metered and less than 5,000 square feet; exempt from the shut-off requirement.

- **Override for Building Lighting Shut-off**

  The automatic building shut-off system is provided with a manual accessible override switch in sight of the lights. The area of override is not to exceed 5,000 square feet.

- **Automatic Control Devices Certified**

  All automatic control devices specified are certified, all alternate equipment shall be certified and installed as directed by the manufacturer.

- **Fluorescent Ballast and Luminaires Certified**

  All fluorescent fixtures subject to certification and specified for the projects are certified.

Example 5-20: Sample Notes: Lighting Mandatory Measures (continued)

- **Tandem Wiring for Two-Lamp Ballast's**

  All one and three lamp fluorescent fixtures are tandem wired with two (2) lamp ballast where required by *Standards* Section 132; or

  All three lamp fluorescent fixtures are specified with electronic high-frequency ballast's and are exempt from two-lamp tandem wiring requirements.

- **Individual Room/Area Controls**

  Each room and area in this building is equipped with a separate switch or occupancy sensor device for each area with floor-to-ceiling walls.

- **Uniform Reduction for Individual Rooms**

  All rooms and areas greater than 100 square feet and more than 1.0 watts per square foot of lighting load shall be controlled with Bi-level switching for uniform reduction of lighting within the room.

- **Daylit Area Control**

  All rooms with windows and skylights, that are greater than 250 square feet, and that allow for the effective use of daylight in the area shall have 50 percent of the lamps in each daylit area controlled by a separate switch; or

  The effective use of daylight throughout cannot be accomplished because the windows are continuously shaded by a building on the adjacent lot. Diagram of shading during different times of year is included on plans.

- **Control of Exterior Lights**

  Exterior mounted fixtures and served from the electrical panel inside the building are controlled with a directional photo cell control on the roof and a corresponding relay in the electrical panel.

The above notes are only examples of wording. Each mandatory measure that requires a separate note should be listed on the plans.

To verify certification, use one of the following options:

1. The Energy Hotline (see above) can verify certification of appliances not found in the above directories.

2. The Energy Commission's Web Site includes listings of energy efficient appliances for several appliance types. The web site address is www.energy.ca.gov/efficiency/appliances/.

3. The complete appliance databases can be downloaded from the Energy Commission's Internet FTP site (ftp://sna.com/pub/users/efftech/appliances). This requires database software (spreadsheet programs cannot handle some of the larger files). To use the data, a user must download the database file (or files), download a brand file and a manufacturer file and then decompress these files. Then download a description file that provides details on what is contained in each of the data fields. With these files, and using database software, the data can be sorted and manipulated.

Documenting the mandatory measures on the plans is accomplished through a confirmation statement, notes and actual equipment location as identified on the plans. The plans should clearly indicate the location and type of all mandatory control devices; such as manual switches, reduced level control, daylit area, controls, building shut-off and overrides, and exterior light controls.

B. LTG-1 Part 2

Part 2 of LTG-1 should be used to describe the lighting fixtures and control devices designed to be installed in the building. The information on this form may, with the approval of the building official, be incorporated into equipment schedules on the plans, rather than presented on the LTG-1 Part 2 form. If this is done, however, the same information should be included in one schedule in a format similar to the Energy Commission form.

Installed Lighting Schedule

CODE each luminaire type is described by name, code or type as shown on the plans.

LUMINAIRE DESCRIPTION lists the type (Incandescent, Fluorescent or High-intensity discharge) of lamp

NO. OF LAMPS, lists the number of lamps per fixture. If track lighting is used, and the fixtures are not shown on the plans, the length of track is entered in this column.

WATTS/LAMP is the listed watts per lamp. For track, and incandescent medium base socket fixtures, see Section 5.2.4 for how to determine the watts of these types of luminaires. If track lighting is used, and the fixtures are not shown on the plans, 45 watts per foot of track is entered in this column. For low voltage lighting, enter the voltage ampere (VA) rating of the transformer. For any neon lighting required to be included in lighting wattage calculations, enter the transformer watts.

TYPE DESCRIPTION indicates the ballast type: Standard energy saving magnetic (S), Electronic High Frequency (E), or Other (O). If E or O ballast types are used, the exact ballast type and model number should be specified on the plans.

LUMINAIRE

NO. OF BALLAST lists the number of ballasts installed in each luminaire.

WATTS indicates the total lamp and ballast wattage.

TOTAL WATTS enter total wattage from both watts per lamp and ballast.

Mandatory Automatic Controls

The Mandatory Automatic Controls portion is where those devices to meet the mandatory control requirements are listed, that would include devices for building shut-off, individual room control and control of exterior lights.

CONTROL LOCATION lists the location(s) or room number(s) of the controls and should match the plans.

CONTROL IDENTIFICATION lists the symbol of the control and should match the plans.

CONTROL TYPE lists the type of certified control device used to meet the mandatory automatic control requirement.

SPACE CONTROLLED lists the location of controlled lights.

Typical controls may be covered by general notation.

Controls for Credit

The Controls for Credit portion is similar to the Mandatory Automatic Controls portion. The only difference is in the last column.

CONTROL LOCATION lists the location(s) or room number(s) of the controls and should match the plans.

CONTROL IDENTIFICATION lists the symbol of the control and should match the plans.

CONTROL TYPE lists the type of certified control device used to meet the automatic control requirement. Such controls are, occupant, daylight, dimming sensors etc.

LUMINAIRES CONTROLLED should list the luminaire type and quantity controlled for credit.

TYPE should use the same name as on the plans.

 # OF LUMEN should indicate the number of luminaires of that type that are controlled by the control type.

Typical controls may be covered by a general plan notation.

Notes to Field

This space is for use by the building department plans examiner to alert the field inspector to look for important inspection items.

C. Sample Form: LTG-1 Certificate of Compliance

CERTIFICATE OF COMPLIANCE (Part 1 of 2) LTG-1

PROJECT NAME		DATE
PROJECT ADDRESS		
PRINCIPAL DESIGNER-LIGHTING	TELEPHONE	Building Permit #
DOCUMENTATION AUTHOR	TELEPHONE	Checked by/Date Enforcement Agency Use

GENERAL INFORMATION

DATE OF PLANS	BUILDING CONDITIONED FLOOR AREA	CLIMATE ZONE

BUILDING TYPE ☐ NONRESIDENTIAL ☐ HIGH RISE RESIDENTIAL ☐ HOTEL/MOTEL GUEST ROOM

PHASE OF CONSTRUCTION ☐ NEW CONSTRUCTION ☐ ADDITION ☐ ALTERATION ☐ UNCONDITIONED (file affidavit)

METHOD OF LIGHTING COMPLIANCE ☐ COMPLETE BLDG. ☐ AREA CATEGORY ☐ TAILORED ☐ PERFORMANCE

STATEMENT OF COMPLIANCE

This Certificate of Compliance lists the building features and performance specifications need to comply with Title 24, Parts 1 and 6 of the California Code of Regulations. This certificate applies only to building lighting requirements.

The documentation preparer hereby certifies that the documentation is accurate and complete.

DOCUMENTATION AUTHOR	SIGNATURE	DATE

The Principal Lighting Designer hereby certifies that the proposed building design represented in this set of construction documents is consistent with the other compliance forms and worksheets, with the specifications, and with any other calculations submitted with this permit application. The proposed building has been designed to meet the envelope requirements contained in the applicable parts of Sections 110, 119,130 through 132, 146, and 149 of Title 24, Part 6.

Please check one:

☐ I hereby affirm that I am eligible under the provisions of Division 3 of the Business and Professions Code to sign this document as the person responsible for its preparation; and that I am licensed in the State of California as a civil engineer or electrical engineer, or I am a licensed architect.

☐ I affirm that I am eligible under the provisions of Division 3 of the Business and Professions Code by section 5537.2 or 6737.3 to sign this document as the person responsible for its preparation; and that I am a licensed contractor performing this work.

☐ I affirm that I am eligible under Division 3 of the Business and Professions Code to sign this document because it pertains to a structure or type of work described as exempt pursuant to Business and Professions Code Sections 5537,5538 and 6737.1.

(These sections of the Business and Professions Code are printed in full in the Nonresidential Manual.)

PRINCIPAL LIGHTING DESIGNER-NAME	SIGNATURE	DATE	LIC. #

LIGHTING MANDATORY MEASURES

Indicate location on plans of Note Block for Mandatory Measure _____

INSTRUCTIONS TO APPLICANT

For detailed instructions on the use of this and all Energy Efficiency Standards compliance forms, please refer to the Nonresidential Manual published by the California Energy Commission.
LTG-1: Required on plans for all submittals. Part 2 may be incorporated in schedules on plans.
LTG-2: Required for all submittals.
LTG-3: Optional. Use only if lighting control credits are taken.
LTG-4: Optional. Use only if Tailored Method is used. Parts 2 and 3 used only if applicable.

CERTIFICATE OF COMPLIANCE (Part 2 of 2) LTG-1

PROJECT NAME	DATE

INSTALLED LIGHTING SCHEDULE

Code	LUMINAIRE DESCRIPTION	LAMPS Type DESCRIPTION	LAMPS #	LAMPS Watts Per Lamp	BALLASTS Type DESCRIPTION	BALLASTS #	Luminaire (Lamp + Ballast) #	Luminaire (Lamp + Ballast) Watts	TOTAL WATTS

SUBTOTAL FROM THIS PAGE	
BUILDING TOTAL	
LESS CONTROL CREDIT WATTS (From LTG-3)	
ADJUSTED ACTUAL WATTS	

MANDATORY AUTOMATIC CONTROLS

CONTROL LOCATION (Room #)	CONTROL IDENTIFICATION	CONTROL TYPE (Auto Time Switch, Exterior, etc.)	SPACE CONTROLED	NOTE TO FIELD

CONTROLS FOR CREDIT

CONTROL LOCATION (Room # or Dwg. #)	CONTROL IDENTIFICATION	CONTROL TYPE (Occupant, Daylight, Dimming, etc.)	LUMINAIRES CONTROLLED TYPE	LUMINAIRES CONTROLLED # OF LUMINAIRES	NOTE TO FIELD

NOTES TO FIELD - For Building Department Use Only

5.3.2 LTG-2: Lighting Compliance Summary

Form LTG-2 (Lighting Compliance) should be completed and submitted with all applications, while LTG-3 (Control Credits) and LTG-4 (Tailored Method) should be included with LTG-2 only when that method is used. While these forms are not required to be on the plans (they may be submitted separately in the energy compliance package), the designer may include them in the lighting equipment schedules provided the information is in a similar format.

A. Actual Lighting Power

The Actual Lighting Power (Adjusted) is calculated by completing this form.

LUMINAIRE NAMES shall be listed by name or symbol.

DESCRIPTION should indicate a short list of the technical features.

NUMBER OF LUMINAIRES lists the quantity of each fixture type in the building. If track lighting is used, and the fixtures are not shown on the plans, the length of track is entered in this column.

WATTS PER LUMINAIRE lists the total wattage of each luminaire type (including ballasts for fluorescent or high intensity discharge fixtures). For track and incandescent medium base socket fixtures see Section 5.2.4 for how to determine the watts of these types of luminaires. If track lighting is used, and the fixtures are not shown on the plans, 45 watts per foot of track is entered in this column.

CEC DEFAULT is a check to indicate if the wattage is a standard value from the data in Appendix B, Table B-11, or a nonstandard value. Nonstandard values must be substantiated with manufacturer's data sheets.

TOTAL WATTS is the product of the quantity of each luminaire listed times its watts per luminaire.

Subtotal the total watts for each luminaire and subtract the control credits, if any, from form LTG-3. The results are the Actual Lighting Power (Adjusted) for the building. This total cannot be greater than the Allowed Lighting Power calculated below.

B. Allowed Lighting Power

The Allowed Lighting Power is determined by calculating the maximum total watts of lighting that may be installed. There are four different methods that may be used. These methods may not be mixed in the same building permit application.

Complete Building Method

This method may only be used when plans and specifications for the entire building are included in the permit application.

BUILDING CATEGORY is taken from Table 5-3 for the occupancy of the building. If the building has a mixture of occupancies, the mixed occupancy rules determine the major occupancy of the building (the major occupancy must be at least 90 percent of the conditioned floor area). If there is not a major occupancy, this method may not be used.

WATTS PER SF for that building type is taken from Table 5-3 and entered here.

COMPLETE BUILDING AREA is the conditioned floor area of the entire building, including the conditioned floor area of minor occupancies.

ALLOWED WATTS is the product of the watts per square foot times the complete building area. This becomes the Allowed Lighting Power for the building.

Area Category Method

This method may be used when different primary function areas of a building are included in the permit application.

AREA CATEGORY is taken from Table 5-4 for the primary function of the area. If the building has a mixture of areas, each function area must be listed separately.

WATTS PER SF for that building type is taken from Table 5-4 and entered here.

AREA (SF) is the conditioned floor area of the primary function area measured from the inside of bounding partitions (Section 5.2.2 B).

ALLOWED WATTS is the product of the watts per square foot times the primary function area. This becomes the Allowed Lighting Power for the area.

The sum of the Allowed Lighting Power for each primary function area is the Allowed Lighting Power for the building.

Tailored Method

When the Tailored Method is used, the LTG-4 forms, or a similar form, must be included in the compliance submittal.
TOTAL ALLOWED WATTS is entered here from line 4, of LTG-4: Tailored LPD Summary and Worksheet, Part 1 of 3.

C. Sample Form: LTG-2 Lighting Compliance Summary

LIGHTING COMPLIANCE SUMMARY LTG-2

PROJECT NAME	DATE

ACTUAL LIGHTING POWER

LUMINAIRE NAME	DESCRIPTION	NUMBER OF LUMINAIRES	WATTS PER LUMINAIRE (Including Ballast)	CEC DEFAULT? Y	CEC DEFAULT? N	TOTAL WATTS
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	

SUBTOTAL FROM THIS PAGE	
PLUS SUBTOTAL FROM CONTINUATION PAGE	
LESS CONTROL CREDIT WATTS (From LTG-3)	
ADJUSTED ACTUAL WATTS	

If not using the CEC Default value, please provide supporting documentation.

ALLOWED LIGHTING POWER (Choose One Method)

COMPLETE BUILDING METHOD

BUILDING CATEGORY (From § 146(b) Table 1-M)	WATTS PER SF	COMPLETE BLDG. AREA	ALLOWED WATTS

AREA CATEGORY METHOD

AREA CATEGORY (From § 146(b) Table 1-N)	WATTS PER SF	AREA (SF)	ALLOWED WATTS
TOTALS		AREA	WATTS

TAILORED METHOD

TOTAL ALLOWED WATTS (From LTG-4. or from Computer Run)	

5.3.3 LTG-3: Lighting Controls Credit Worksheet

When certain types of automatic lighting controls listed in Table 5-10 are used, a credit is permitted. This table also lists some restrictions that must be met in order to take credit for the controls.

Lighting control credits are documented on form LTG-3. This requires a specific listing of each device that is used for credit and listing those luminaires controlled by that device.

Column A list the room where the control device is controlling luminaires.

Column B lists a description of that device.

Column C indicates where on the plan set the controls are shown.

Column D indicates the area of the room in which the controls are located.

Column E is used to indicate the room ratio for determining the daylighting control credit and is described in Section 5.2.1. The window wall ratio for the window in the room should be used for vertical daylighting configurations. The skylight well opening (at the ceiling level) to roof/ceiling area should be used for horizontal daylighting configurations.

Column F is used to indicate the visible light transmittance of the aperture. The visible light transmittance is determined in Section 5.2.1

Column G is used to document the total watts of controlled lighting in each room.

Column H is used to indicate the Power Savings Adjustment Factor for that specific control device and is obtained from Table 5-10.

Column I is the sum of Column G (Watts of Control Lighting) times Column H (Lighting Adjustment Factor).

The total Control Credit Watts (entered on LTG-3) is the sum of the Control Credit Watts in Column I. This credit is subtracted from the total installed watts to determine the Actual Lighting Power (Adjusted).

A. Sample Form: LTG-3 Lighting Controls Credit Worksheet

LIGHTING CONTROLS CREDIT WORKSHEET LTG-3

PROJECT NAME | DATE

WORKSHEET

A	B	C	D	E	F	G	H	I
			ROOM	DAYLIGHTING		WATTS OF	LIGHTING	CONTROL
ROOM # ZONE ID	LIGHTING CONTROL DESCRIPTION	PLANS REF.	AREA (SF)	ROOM RATIO*	GLAZING VLT	CONTROL LIGHTING	ADJUSTMENT FACTOR	CREDIT WATTS (G X H)

*For windows, use the Window Wall Ratio for the room. For skylights, use the Skylight-to Roof ratio for the room.

PAGE TOTAL →

BUILDING TOTAL →

Enter on LTG-2: Actual lighting Power calculation

5.3.4 LTG-4: Tailored LPD Summary and Worksheet

The Tailored Method is the most detailed method of calculation for the Allowed Lighting Power. The Allowed Lighting Power is determined on the individual needs of each task. This method is appropriate for buildings that have unusual lighting needs and in some cases, can increase the Allowed Lighting Power to meet those needs. For a complete description of this method, refer to Section 5.2.2C of this Manual.

A. LTG-4: Part 1 of 3

This form should be submitted with all Tailored Method applications. It summarizes the results of the different parts of LTG-4, and includes the Allowed Lighting Power calculations for Illuminance Categories A, B, C and D.

Tailored Lighting Summary

The Allowed Watts is the summation for the building, included at the top of Part 1 of form LTG-4.

Line 1. is the buildings total allowed watts for Illuminance Categories A through D, and the Gross Sales Floor Area. This value is obtained from the bottom right corner of this form.

Line 2. is the buildings total allowed watts for illuminance categories E through I, and the Gross Sales Wall Area. This value is obtained from the Building Total entry on LTG-4, Part 2.

Line 3. is the buildings total allowed watts for display lighting. This value is obtained from the Total Watts entries on LTG-4, Part 2 and Part 3. Each display allotment is separately calculated and entered into the appropriate column on this form.

Line 4. is the sum of lines 1, 2, and 3. The Total Allowed Watts is the Allowed Lighting Power using the Tailored Method.

Tailored LPD- Illuminance Categories A, B, C, D and Gross Sales Floor Area

To complete the lower portion of Part 1 of this form, complete the following steps.

Column A lists the room number of space designation and should correspond with the plans.

Column B lists the task or activity that will occur in the room or space.

Column C lists the Illuminance Category for the room or space. This is determined by using either Table 5-5, Table B-10 of Appendix B, or the IES Handbook, Applications Volume, 1987. Additional information is included in Section 5.2.2C. of this Manual..

Column D lists the room cavity ratio (RCR) of each room or space. A RCR of less than 3.5 may be assumed for any room. Table 5-6 in Section 5.2.2C. includes the RCR of simple spaces. The LTG-5 may be used to calculate an RCR greater than or equal to 3.5.

Column E lists the actual floor area of the room or space from the plans. The area is determined by measuring from the inside of the partitions that bound the task area.

Column F lists the allowed lighting power density from Table 5-7 (Standards Table No. 1-R) using the Illuminance Category (Column C) and room cavity ratio (Column D) for each room. For Gross Sales Floor Areas, this value can be no more than 2.0 watts per square foot.

Column G is the product of the floor area times allowed lighting power density. The total for all rooms or spaces that contain task activities that fall within Illuminance Categories A through D entered in line 1 at the top of LTG-4, Part 1.

B. LTG-4 Part 2 of 3

Tailored LPD - Illuminance Categories E, F, G, H, I and Gross Sales Wall Area

To complete the upper portion of Part 2 of this form, complete the following steps.

Column A lists the task or activity that will occur in the room or space. Gross Sales Wall Areas do not include architectural features that prevent the use of the wall for the display of merchandise. See Section 5.2.2C for more information on how to calculate the areas of tasks or activities.

Column B lists the Illuminance Category for the room or space. This is determined according to Table 5-5 of Appendix B, Table B-10, Illuminance Categories, or using the IES Handbook Application Volume, 1987. Additional information is included in Section 5.2.2C. of this Manual.

Column C lists the room cavity ratio (RCR) of each room or space that requires the use of Illuminance Category E. A RCR of less than 3.5 may be assumed for any room. Table 5-6 in Section 5.2.2C. includes the RCRs of simple spaces. The LTG-5 may be used to calculate an RCR greater than or equal to 3.5.

Column D lists either the mounting height, throw distance, or both (if both are used), for the luminaires. Section 5.2.2C contains a discussion on how to determine the mounting height and throw distance of luminaires.

Column E lists the actual floor area of the room or space from the plans. The area is determined by measuring from the inside of the partitions, if any, that bound the task area.

Column F lists the allowed LPD from Table 5-9 (Standards Table No. 1-R) using the Illuminance Category (Column B), room cavity ratio for Illuminance Category E (Column C) rooms or spaces, and mounting height/throw distance adjustment factors (Column D) for display luminaires. For Gross Sales Wall Areas, this value can be no more than 2.0 watts per square foot.

Column G is the product of the floor area times allowed LPD (Column E times Column F).

Column H lists the luminaire name (consistent with LTG-1 and 2) that is illuminating the task or activity. If more than one luminaire type is used to illuminate the task or activity, each type must be separately listed. Multiple lines on this form may be used for this list.

Column I lists the quantity of luminaires used to illuminate the task or activity. If track lighting is used, and the plans do not indicate the number of fixtures to be used on the track, the actual length of track is entered in this column.

Column J lists the total wattage of each luminaire type (including ballasts for fluorescent or high intensity discharge fixtures). For track, and incandescent medium base socket fixtures, see Section 5.2.4 for how to determine the watts of these types of luminaires. If track lighting is used, and the fixtures are not shown on the plans, 45 watts per foot of track is entered in this column.

Column K is the product of the quantity of luminaires (Column I) times the watts per luminaire (Column J). If more than one luminaire type is used to illuminate the task or activity, the subtotal for all the luminaires illuminating the task should be indicated in this column on a separate line of the form.

Decorative Chandeliers and Sconces are allowed the smaller of 20.0 watts per cubic foot, one (1) watt per square foot times the area of the task space that the chandelier or sconce is in, or the actual design wattage of the chandelier or sconce. These displays may use the Illuminance Category E through I form to determine the Allowed Lighting Power for these displays.

Enter the smaller of 20.0 watts per cubic foot of chandelier or sconce volume, or one (1) watt per square foot of area that the chandelier or sconce is in Column G. If volume is used to determine the Allotted Watts in Column G, enter the area of the task space in Column D (Notes), the volume in cubic feet in Column E and the 20.0 watt per cubic foot allotment in Column F. If area was used to determine the Allotted Watts in Column G, enter the volume in Column D (Notes), the area in *Column E*

and one (1) watt per square foot in column F. Enter the chandelier or sconce name in Column H, the quantity in Column I and the watts per luminaire in Column J.

Column L is the lesser of either the Allotted Watts (Column G) or the Design Watts (Column K).

The sum of the Allowed Watts in Column L is entered on Line 2, Part 1 of LTG-4.

Tailored Lighting - Public Area Displays

When public areas include feature display lighting, it must be documented according to the floor display lighting procedure established in Section 5.2.2C. To complete the lower portion of Part 2 of LTG-4, complete the following steps.

Column A lists the name of the Section 5.2.2C for definition of Public Area Displays.

Column B lists the throw distance of the display luminaires. Section 5.2.2C contains a discussion on how to determine the throw distance of display luminaires.

Column C lists the mounting height for display luminaires. Section 5.2.2C contains a discussion on how to determine the mounting height of display luminaires.

Column D lists the actual area of the display from the plans. This area must be totaled at the bottom of the column. Additional public display allowances cannot be taken for public displays exceeding 10 percent of the public area. Section 5.2.2C. contains a discussion on how to determine the area of the display.

Column E lists the allowed lighting power density from Table 5-8 using the mounting height/throw distance adjustment factors (Columns C and D) for display luminaires.

Column F is the product of the task area (Column D) times allowed lighting power density (Column E.)

Column G lists the luminaire name (consistent with LTG-1 and 2) that is illuminating the display. If more than one luminaire type is used to illuminate the display, each type must be separately listed. Multiple lines on this form may be used for this list.

Column H lists the quantity of luminaires used to illuminate the display. If track lighting is used, and the plans do not indicate the number of fixtures to be used on the track, the actual length of track is entered in this column.

Column I lists the total wattage of each luminaire type (including ballasts for fluorescent or high intensity discharge fixtures). For track, and incandescent medium base socket fixtures, see Section 5.2.4 for how to determine the watts of these types of luminaires. If track lighting is used, and the fixtures are not shown on the plans, 45 watts per foot of track is entered in this column.

Column J is the product of the quantity of luminaires (Column H) times the watts per luminaire (Column I). If more than one luminaire type is used to illuminate the task or activity, the subtotal for all the luminaires illuminating the task should be indicated in this column on a separate line of the form.

Column K is the lesser of either the Allotted Watts (Column F) or the Design Watts (Column J).

The sum of the Allowed Watts in Column K is entered on Line 3, Part 1 of LTG-4.

C. LTG-4: Part 3 of 3

Tailored Lighting - Sales Feature Floor Displays

When retail spaces include sales feature floor display lighting, it must be documented according to the display lighting procedure established in Section 5.2.2C. An allotment of 1,000 watts is permitted for sales feature floor displays in lieu of performing this calculation, if the gross sales area of the entire building is less than 800 square feet.
Complete the upper portion of Part 3 of this LTG-4, complete the following steps.

Column A lists the name of the sales feature floor display. See Section 5.2.2C for more information on the definition of Sales Feature Floor Displays.

Column B lists the throw distance of the display luminaires. Section 5.2.2C contains a discussion on how to determine the throw distance of display luminaires.

Column C lists the mounting height for display luminaires. Section 5.2.2C contains a discussion on how to determine the mounting height of display luminaires.

Column D lists the actual floor area of the display from the plans. This area must be totaled at the bottom of the column. Additional Sales Feature Floor Display allowances cannot be taken for displays exceeding 10 percent of the gross sales floor area. Section 5.2.2C contains a discussion on how to determine the area of the Sales Feature Floor Displays.

Column E lists the allowed lighting power density from Table 5-8 using the mounting height/throw distance adjustment factors (Columns C and D) for display luminaires. This allowance will always be based on Illuminance Category G.

Column F is the product of the task area (Column D) times the Illuminance Category G lighting power density (Column E.)

Column G lists the luminaire name (consistent with LTG-1 and 2) that is illuminating the display. If more than one luminaire type is used to illuminate the display, each type must be separately listed. Multiple lines on this form may be used for this list.

Column H lists the quantity of luminaires used to illuminate the display. If track lighting is used, and the plans do not indicate the number of fixtures to be used on the track, the actual length of track is entered in this column.

Column I lists the total wattage of each luminaire type (including ballasts for fluorescent or high intensity discharge fixtures). For track, and incandescent medium base socket fixtures, see Section 5.2.4 for how to determine the watts of these types of luminaires. If track lighting is used, and the fixtures are not shown on the plans, 45 watts per foot of track is entered in this column.

Column J is the product of the quantity of luminaires (Column H) times the watts per luminaire (Column I). If more than one luminaire type is used to illuminate the task or activity, the subtotal for all the luminaires illuminating the task should be indicated in this column on a separate line of the form.

Column K is the lesser of either the Allotted Watts (Column F) or the Design Watts (Column J).

Valuable Merchandise Display Cases that contain jewelry and other valuable merchandise are allowed 20.0 watts per square foot for each square foot of lighted display case counter top. These displays may use the Sales Feature Floor Display form to determine the Allowed Lighting Power for these displays.

Enter the area of the lighted display case counter top in Column D, and the 20.0 watts per square foot allotment in Column E. The area should not be included in the total Sales Feature Floor Display area. Enter the luminaire name used to illuminate the lighted display counter top in Column G, the quantity in Column H, and the watts per luminaire in Column J.

Detailed documentation must be provided on the plans that shows the placement of display cases, specific dimensions, and details of proposed lighting systems.

The sum of the Allowed Watts for Sales Feature Floor Displays in Column K is entered on Line 3, Part 1 of LTG-4.

As with all applications in Illuminance Category G, the allowed lighting watts for feature displays may not exceed the actual installed wattage. This prevents unused display lighting allotments from being used in other areas of the store.

Tailored LPD - Sales Feature Wall Displays

When retail spaces include sales feature wall display lighting, it must be documented according to the display lighting procedure established in Section 5.2.2C. To complete the lower portion of Part 3 of this form, complete the following steps.

Column A lists the name of the sales feature wall display. See Section 5.2.2C for more information on the definition of Sales Feature Wall Displays.

Column B lists the throw distance of the display luminaires. Section 5.2.2C contains a discussion on how to determine the throw distance of display luminaires.

Column C lists the actual wall area of the display from the plans. This area must be totaled at the bottom of the column. Additional Sales Feature Wall Display allowances cannot be taken for displays exceeding 10 percent of the gross sales wall area. Section 5.2.2C contains a discussion on how to determine the area of the Sales Feature Wall Displays. The Gross Sales Wall Area is limited to the area actually used for display.

Column D lists the allowed lighting power density from Table 5-8 using the mounting throw distance adjustment factors (Columns B and C) for display luminaires. This allowance will always be based on Illuminance Category G.

Column E is the product of the task area (Column C) times allowed lighting power density (Column D.)

Column F lists the luminaire name (consistent with LTG-1 and 2) that is illuminating the display. If more than one luminaire type is used to illuminate the display, each type must be separately listed. Multiple lines on this form may be used for this list.

Column G lists the quantity of luminaires used to illuminate the display. If track lighting is used, and the plans do not indicate the number of fixtures to be used on the track, the actual length of track is entered in this column.

Column H lists the total wattage of each luminaire type (including ballasts for fluorescent or high intensity discharge fixtures). For track, and incandescent medium base socket fixtures, see Section 5.2.4 for how to determine the watts of these types of luminaires. If track lighting is used, and the fixtures are not shown on the plans, 45 watts per foot of track is entered in this column.

Column I is the product of the quantity of luminaires (Column G) times the watts per luminaire (Column H). If more than one luminaire type is used to illuminate the task or activity, the subtotal for all the luminaires illuminating the task should be indicated in this column on a separate line of the form.

Column J is the lesser of either the Allotted Watts (Column E) or the Design Watts (Column I).

The sum of the Allowed Watts for Sales Feature Wall Displays in Column J is entered on Line 3, Part 1 of LTG-4.

As with all applications in Illuminance Category G, the allowed lighting watts for feature displays may not exceed the actual installed wattage. This prevents unused display lighting allotments from being used in other areas of the store.

D. Sample Form: LTG-4 Tailored LPD Summary and Worksheet

TAILORED LPD SUMMARY and WORKSHEET (Part 1 of 3) LTG-4

PROJECT NAME	DATE

TAILORED LPD SUMMARY

1. Watts for Illuminance Categories A-D (from column G below) → _____ WATTS

2. Watts for Illuminance Categories E-I (from LTG-4 Part 2) → _____ WATTS

3. Watts for Display Lighting (from LTG-4 Parts 2 & 3)

_____	+	_____	+	_____	=	_____ WATTS
Public Area Display		Sales Feature Floor Display		Sales Feature Wall Display		

4. Total Allowed Watts (lines 1+2+3) → _____ WATTS

TAILORED LPD - Illuminance Categories A, B, C and D and Gross Sales Floor Area

A	B	C	D	E	F	G
ROOM NUMBER	TASK/ACTIVITY	ILLUMINANCE CATEGORY	ROOM CAVITY RATIO	FLOOR AREA	ALLOWED LPD	ALLOWED WATTS (E X F)
			PAGE TOTAL →			
			BUILDING TOTAL →			
				SF		WATTS

TAILORED LPD SUMMARY and WORKSHEET (Part 2 of 3) LTG-4

PROJECT NAME	DATE

TAILORED LPD - Illuminance Categories E, F, G, H, I and Gross Sales Wall Area

A	B	C	D	E	F	G	H	I	J	K	L
				ALLOTTED WATTS			DESIGN WATTS				
TASK / ACTIVITY	Illum. Cat.	RCR (If E)	Notes*	TASK AREA (sf)	ALLOWED LPD	ALLOTTED WATTS (E X F)	LUMIN. CODE	QTY.	WATTS/ LUMIN.	DESIGN WATTS (I X J)	**ALLOWED WATTS** (Min. G or K)

PAGE TOTAL →

BUILDING TOTAL →

* Enter Mounting Height or Throw Distance if applicable.

TAILORED LPD - Public Area Displays

A	B	C	D	E	F	G	H	I	J	K
			ALLOTTED WATTS			DESIGN WATTS				
TASK / ACTIVITY	THROW DISTANCE	MOUNT. HEIGHT	TASK AREA (sf)	ALLOWED LPD	ALLOTTED WATTS (E X F)	LUMIN. CODE	QTY.	WATTS/ LUMIN.	DESIGN WATTS (H X I)	**ALLOWED WATTS** (Min. F or J)

TOTAL AREA PUBLIC DISPLAYS ____ SF

TOTAL ____ WATTS

PLANE OF PUBLIC DISPLAY AREA ____ X 0.1 = ____ MAXIMUM AREA PUBLIC DISPLAYS (SF)

TAILORED LPD SUMMARY and WORKSHEET (Part 3 of 3) LTG-4

PROJECT NAME	DATE

TAILORED LPD - Sales Feature Floor Displays

A	B	C	D	E	F	G	H	I	J	K
			ALLOTTED WATTS			DESIGN WATTS				
TASK / ACTIVITY	THROW DISTANCE	MOUNT. HEIGHT	TASK AREA (sf)	ALLOWED LPD	ALLOTTED WATTS (D X E)	LUMIN. CODE	QTY.	WATTS/ LUMIN.	DESIGN WATTS (H X I)	**ALLOWED WATTS** (Min. F or J)

TOTAL AREA FLOOR DISPLAYS ____ SF TOTAL WATTS ____

GROSS SALES FLOOR AREA ____ X 0.1 = ____ MAXIMUM AREA FLOOR DISPLAYS (SF)

TAILORED LPD - Sales Feature Wall Displays

A	B	C	D	E	F	G	H	I	J
		ALLOTTED WATTS			DESIGN WATTS				
TASK ACTIVITY	THROW DISTANCE	TASK AREA (sf)	ALLOWED LPD	ALLOTTED WATTS (C X D)	LUMIN. CODE	QTY.	WATTS/ LUMIN.	DESIGN WATTS (G XH)	**ALLOWED WATTS** (Min. E or I)

TOTAL AREA WALL DISPLAYS ____ SF TOTAL WATTS ____

GROSS SALES WALL AREA ____ X 0.1 = ____ MAXIMUM AREA WALL DISPLAYS (SF)

5.3.5 LTG-5: Room Cavity Ratio Worksheet (≥3.5)

Form LTG-5 is an optional form only to be used in conjunction with the Tailored Method and form LTG-4. LTG-5 documents the calculation of room cavity ratios (RCRs) which are greater than or equal to 3.5 for spaces in illuminance categories A-E.

Rooms in the building which are relatively large generally have a high RCR. If the RCR is greater than or equal to 3.5, a higher LPD is allowed (see Table 5-7). If the RCR is less than 3.5, it does not need to be included on this form.

The form has two sections: **Rectangular Spaces** is for rooms with four 90° walls, and **Non-rectangular Spaces** is for all other room types (including oblique four walled and circular rooms).

A. Rectangular Spaces

Column A lists each rooms number, and should correspond to the plans.

Column B lists the task/activity description for the room. If the room has multiple tasks or activities, use the dominant activity for the room in this column.

Column C lists the Length (L) of the room, measured in feet, from the interior surfaces of opposing walls. The length is typically the longest distance between two parallel walls in the room.

Column D lists the Width (W) of the room, measured in feet, from the interior surfaces of opposing walls. The width is typically the smallest distance between two parallel walls in the room.

Column E lists the vertical distance, measured in feet, from the work plane to the center line of the lighting fixture. This measurement is called the Room Cavity Height (H).

Column F is 5 times the product of the Room Cavity Height H (from Column E) and the sum of the room Length and Width L (from Column C plus W from Column D), all divided by the Room Area L (from Column C) times Room Width (W from Column D). This quantity is the RCR and should be entered in Column D of Part 1 of LTG-4 for tasks with illuminance categories A-D or in Column C of the top section of Part 2 of LTG-4 for tasks with illuminance category E.

B. Nonrectangular Spaces

Column A lists each rooms number, and should correspond with the plans.

Column B lists the area or activity description for the room. If the room has multiple tasks or activities, use the dominant activity for the room in this column.

Column C lists the interior Area (A) of the room in square feet. This should be determined by whatever means appropriate for the shape of the room.

Column D lists the Room Perimeter (P) measured in feet along the interior surfaces of the walls which define the boundaries of the room. For rooms with angled walls, this is the sum of the interior lengths of each wall in the room. For circular rooms, This is the interior radius of the room, squared, times pi (3.413).

Column E lists the vertical distance, measured in feet, from the work plane to the center line of the lighting fixture. This measurement is called the Room Cavity Height (H).

Column F is 2.5 times the product of the Room Cavity Height H (from Column E) and Room Perimeter P (from Column D), all divided by the Room Area A (from Column C). This quantity is the RCR and should be entered in Column D of Part 1 of LTG-4 for tasks with illuminance categories A-D or in Column C of the top section of Part 2 of LTG-4 for tasks with illuminance category E.

C. Sample Form: LTG-5 Room Cavity Ratio Worksheet (RCR ≥ 3.5)

ROOM CAVITY RATIO WORKSHEET (RCR ≥ 3.5) LTG-5

PROJECT NAME		FOR ENFORCEMENT AGENCY USE ONLY	
DOCUMENTATION AUTHOR	DATE	PLAN CHECKED BY	DATE

RECTANGULAR SPACES

A	B	C	D	E	F
Room Number	Task/Activity Description	Room Length (L)	Room Width (W)	Room Cavity Height (H)	Room Cav. Ratio 5 x H x (L+W) / (L x W)

NON-RECTANGULAR SPACES

A	B	C	D	E	F
Room Number	Task/Activity Description	Room Area (A)	Room Perimeter (P)	Room Cavity Height (H)	Room Cav. Ratio 2.5 x H x P /A

5.4 LIGHTING INSPECTION

The electrical building inspection process for energy compliance is carried out along with the other building inspections performed by the building department. The inspector relies upon the plans and upon the LTG-1 Certificate of Compliance form printed on the plans (See Section 5.3.1). Included on the LTG-1 are “Notes to Field” that are provided by the plans examiner to alert the field inspector to items of special interest for field verification.

To assist in the inspection process, an Inspection Checklist is provided in Appendix I.

Chapter 5 Index

A

Accessibility · 10
Actual Lighting Power · 1, 3, 9, 25, 37, 41, 42, 43, 44, 55, 58
Actual Lighting Power Calculation · 42
Advanced Lighting Guidelines · 21
Agricultural · 49, 50
Allotted Watts · 61, 62, 63, 64
Allowed Lighting Power · 1, 3, 4, 25, 26, 27, 28, 29, 30, 33, 34, 35, 36, 37, 41, 44, 47, 55, 56, 60, 61, 63
Allowed Lighting Power Density · 33
Allowed Watts · 26, 60, 62, 63, 64
Alterations · 1, 44
Alternative Calculation Method (ACM) · 41
Annunciated · 5, 9
Appliance Efficiency Regulations · 21, 44
Application · 61
Arcades · 8, 28
Area · 1, 2, 3, 4, 5, 6, 7, 8, 10, 13, 25, 26, 27, 28, 29, 30, 33, 34, 37, 38, 39, 40, 41, 51, 55, 62, 68
AREA CATEGORY · 38, 48, 55
Area Category Method · 1, 2, 3, 4, 7, 26, 27, 28, 29, 37, 38, 39, 40, 55
Area Controls · 1, 10, 51
Area of a Task · 33, 34
Automatic Daylighting Controls · 20
Automatic Lighting Control Credits · 9, 44
Automatic Time · 9, 20

B

Ballasts · 1, 21
Bank/financial Institution · 7
Basic Lighting Concepts · 1, 3
Building · 1, 2, 5, 7, 25, 26, 37, 38, 39, 40, 41, 46, 50, 55, 60
Building lighting shut-off · 50
Business and Professions Code · 48

C

California Code of Regulations · 49
Captive-Key Override · 9
Category E · 31, 34, 61
Category G · 35, 63, 64
CEC DEFAULT · 55
Certificate of Compliance · 47, 48, 53, 70
Certified Ballasts XE "Ballasts" and Luminaires · 21
Chandelier · 5, 6, 29
Churches · 30
Classroom · 7
Commercial · 7, 8, 27, 28, 38
Complete Building Approach · 26
COMPLETE BUILDING AREA · 55
Compliance · 1, 3, 55
Control Credit Watts · 58
Control Credits · 1, 55
Control Devices · 1, 9, 19, 50
Control of Exterior Lights · 51
Controls · 1, 11, 16, 44, 52
Controls for Credit · 52
Convention · 7, 27
Corridors · 17, 27, 28, 38, 39, 40

D

DATE OF PLANS · 48
Daylit Area · 1, 5, 11, 12, 13, 14, 15, 44, 51
Density · 25, 38
Design Watts · 62, 63, 64
Determining Allowed Watts · 37
Determining Illuminance Categories · 30
Dimensions · 29
Directory of Automatic Lighting Control Devices · 19
Display Cases · 63
Display Lighting · 1, 4, 5, 19, 35
Display, Public Areas · 35
Documentation · 48
Documentation Author · 48

E

Effective Aperture · 5, 12, 13, 14, 16
Entire Building · 2, 5
ENV-1 · 48
Exempt Lighting · 1, 41
Exercise · 7, 27
Exterior Lights · 1, 19

F

Feature Displays · 30
Floor Area · 35

G

Garages · 49, 50
General Commercial · 7, 27
General Lighting · 3, 33, 35, 36
Glazing · 13
Grocery Store · 7, 27, 28, 39

Gross Exterior Roof Area · 13
Gross Sales Floor Area · 35, 36, 37, 60
Gross Sales Wall Area · 5, 35, 36, 37, 60, 61, 64
Guest Room · 1, 22

H

High Bay · 5, 7, 27
Hotel Function Area · 7, 27
Hotel Lobby · 8, 27
Hotel/Motel · 22, 23, 24

I

IES Handbook · 30, 60, 61
Illuminance Categories · 30, 33, 47, 60, 61
Illuminating Engineering Society (IES) · 29
Industrial · 7, 8, 27, 28
Inspection · 1, 2, 70
Installed Lighting Schedule · 52

L

Lighting · 1, 2, 3, 4, 6, 7, 9, 10, 19, 21, 22, 23, 24, 25, 27, 28, 37, 38, 39, 40, 41, 42, 43, 45, 47, 50, 51, 55, 56, 58, 60, 62
Lighting Compliance Approaches · 2
Lighting Compliance Summary · 47, 55, 56
Lighting Controls · 1, 9, 45, 47, 58
Lighting Controls Credit Worksheet · 47, 58
Lighting Energy Use · 2
Lighting Mandatory Measures · 50, 51
Lighting Plan Check Documents · 1, 2
Lighting Systems · 1
Lighting Trade-off · 3, 4
Lighting Zone · 9
Lobby · 8, 27
LTG-1 · 1, 47, 52, 53, 61, 62, 63, 64, 70
LTG-2 · 1, 41, 44, 47, 48, 55, 56
LTG-3 · 1, 47, 55, 58
LTG-4 · 1, 32, 33, 47, 48, 55, 56, 60, 61, 62, 63, 64, 68
LTG-5 · 1, 32, 60, 61, 68
Lumen Maintenance Device · 9
Luminaries · 22, 25

M

Malls · 8, 28
Mandatory Automatic Controls · 52
Mandatory Measures · 1, 10
Manual Switches · 11
Mechanical Room · 7, 28, 39
Medical · 8, 26, 28
Medium Base Sockets · 43
Mounting Height · 33, 34
Mounting Height Adjustments · 34
Multi-Scene Dimming System · 9
Museum · 8, 27, 28

N

National Electric Code · 42
Newly Conditioned Space · 5
Notes to Field · 53, 70
NUMBER OF LUMINAIRES · 55

O

Occupancy · 1, 7, 26
Office Lighting · 30, 34
Override · 11, 18, 50

P

Performance Approach · 1, 3, 41
PHASE OF CONSTRUCTION · 48
Photocell · 21
Power Savings Adjustment Factor · 58
Prescriptive Approach · 1, 25
Primary Function Areas · 38, 40
Printing · 31
Public Areas · 6, 10

R

Rectangular Shaped Rooms · 32
Reduced Flicker · 6
Repair · 7, 27
Residential Standards · 22
Restaurant · 8
Restroom · 8, 38
Retail · 8, 28, 35, 38, 39, 40
Room Cavity Height · 68
Room Cavity Ratio (RCR) · 6, 31
Room Switching · 10
Room Width · 68

S

Sales Feature Floor Display · 35, 62, 63
Sconces · 28, 61
Scope and Application · 1
Security or Emergency · 10
Semi-Conditioned Space · 46
Shut-off · 11, 18, 44

Skylight · 6, 13, 14, 15, 16
Stack Lighting · 36, 37
Statement of Compliance · 48

T

Tailored Lighting Summary · 60
Tailored Method · 1, 2, 4, 25, 29, 30, 32, 35, 37, 38, 47, 55, 56, 60, 68
Tandem Wiring · 1, 19, 20, 51
Task Area · 30, 35, 37
Task Lighting · 37
Tenant · 1, 37, 46
Theaters · 28
Throw Distance · 6, 33, 34
Total Allowed Lighting Power · 40
TOTAL ALLOWED WATTS · 56
TOTAL WATTS · 52, 55
Track Lighting · 42, 43
Trade-offs · 4
Tuning · 10

U

UBC · 8, 42

V

Valuable Merchandise · 63
Very Valuable Merchandise · 6
Visible Light Transmittance · 6, 13, 14

W

Wall · 5, 13, 35, 36, 63, 64
Wall Area · 13, 35
Well Index · 6, 13, 15, 16
Wholesale · 9, 28
Window Wall Ratio · 6, 13
Windows · 13